NEW SERIES, VOL. XL MAY, 1938 No. 2

The American Journal of Surgery

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EDITORIALS

DIGNITY IN MEDICINE

RECENTLY we attended a dinner tendered to a country general practitioner who had completed fifty years of service in medicine. This gentleman, serving a rural community, has lived through the manifold changes in medical practice which have marked the past half century. He has been active both in community and in medical affairs, has served on countless committees and has been elected to the presidency of his county medical society. He has the respect and affection of his medical colleagues, who know that he is a good doctor, a credit to the profession. Outside of his community he is unknown.

His friends and fellow workers, gathered to do him honor, presented him with a gift, and in acknowledging it, he felt called upon "to say a few words,"—words, which among other things, stated something of the credo and philosophy which had governed his life.

"The medical colleges of today," said he, "are graduating men better equipped than those graduated in my time. Hospitals are more numerous; and there is no comparison between the scientific equipment of the hospital of today and the one of fifty years ago—or even with the one of twenty years ago. The intern today is undoubtedly being well trained.

"But medicine has in it today more of the science than of the art. When I began in practice, the young doctor did not have a dollar sign as his goal. He went into medicine because medicine filled his heart, and he felt it was his destiny in life to serve his fellow humans. He believed in the axiom, 'Do good work and the money will look after itself.' In my lifetime I have done more work with the knowledge that I would receive no remuneration for it than work for which I have been paid.

"I, believe in the ethics of our calling. Our ethics call

for no debate. Economic conditions are no excuse for making changes that will allow of a fuller purse. I believe that every physician should acquaint himself with the problems of the profession, and then vote fearlessly and honestly when the time arrives for their consideration.

"I believe wholeheartedly in the American Medical Association. It represents the backbone, heart and brain of our calling. I believe that every self-respecting physician should be a member of his county medical society and that he should be active in that society. He should cooperate in sending well instructed delegates to the meetings of the state society; they in turn can send on proper delegates to the annual meetings of the American Medical Association. He should abide by the final findings and rulings of the parent body. If individual physicians, or groups of physicians, become free lances and break away from the parent organization just because the majority have voted contrary to their beliefs, disaster is around the corner for American medicine.

"Put up your fight in your state and county societies, but, if defeated, abide by the decisions reached by the majority. Outside groups, groups that go contrary to the decisions reached by the House of Delegates of the American Medical Association, have no part in organized medicine and should be frowned upon.

"I think that today the young man in medicine is concerning himself more with the so-called economic side of his work, especially in his problem of gathering in more and more dollars. He seems to be less concerned in serving his fellows. He is forgetting that medicine is a profession and not a business.

"In my day medicine was a thing of great dignity. I wish that those days could return. In the present day medical schools I would have a part of the curriculum each year devoted to a course of lectures aimed toward the return of dignity to physicians, even though scientific medicine might suffer a bit for the time sacrificed.

"I am glad I have been a physician. I look back on a happy life. It is my honest conviction that medicine is the greatest of all professions."

To all of which we say—"Amen."

T. S. W.

CONGRATULATIONS AND BEST WISHES

THE W. B. Saunders Company has been celebrating this spring its fiftieth anniversary as a publisher of books for the medical profession. The highlight of the festivities was a dinner in Philadelphia on March 4th, given in honor of Mr. Max Brödel, Associate Professor of Art As Applied to Medicine in the School of Medicine of Johns Hopkins University.

The occasion was a very joyous one, with both the publishing field and the physicians of the country well represented. Mr. R. W. Greene, vice-president of the company, gave the address of welcome. Dr. Thomas S. Cullen acted as toastmaster. Dr. Howard A. Kelly spoke of Max Brödel's contributions to the field of gynecology; Dr. Cullen described the creation of the Department of Art As Applied to Medicine in Johns Hopkins; Dr. Morris Fishbein was at his best in a discussion of Max Brödel's influence on medical illustrating; and Mr. Henry L. Mencken read a very witty essay on Max Brödel as a pianist. A portrait in oils of Mr. Brödel, painted by Thomas Corner, was presented to Johns Hopkins by Mr. Lawrence Saunders and accepted for the University by its provost, Dr. Edward W. Berry. Mr. Brödel himself gave one of his characteristically modest talks.

It was an occasion which honored not only the recipient, but also the donor. Max Brödel's work is a milestone in medical art, and the Saunders Company has set many a milestone in medical publishing. We, in the name of The American Journal of Surgery, take this opportunity to offer our sincere congratulations to the W. B. Saunders Company, a medical publishing house with a half century of tradition and creditable performance behind it. We hope that in the next fifty years, further prosperity will come, together with a greater opportunity to serve the medical profession of this country and of the world.

T. S. W.

ORIGINAL ARTICLES

RENAL RICKETS OR RENAL DWARFISM*

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RENAL rickets and renal dwarfism are names which have been applied to a most interesting, yet little described disease of childhood and early adult life. This disease is manifested by rachitic symptoms, asexualism, renal deficiency, and polyuria. The renal deficiency simulates that of a chronic interstitial nephritis, or nephrosclerosis. Apparently renal rickets has no predominant predilection for one sex.

The paucity of reports of this disease in genitourinary literature, except for a paragraph by Hinman[5] in his recent book, *Principles and Practice of Urology*, prompts us to look to the pediatrician and orthopedist for case reports. According to Pfaundler and Schlossman,[10] it was first recognized by Goodhart in 1872, but A. Graeme Mitchell,[8] of Cincinnati, credits Stenier and Neureutter in 1870 with the first description. In 1883, Lucas[7] described in the *Lancet*, "A Form of Late Rickets associated with Albuminuria." He was of the opinion that albumin occurred too often in rickets of adolescence to be a mere chance finding. Hunt[6] says the average duration of life after the appearance of the bone deformity is less than two years. Up to 1927 there had been but fifty-three recorded cases, and only seven in American literature. The number still remains under 100, but urologists are probably seeing this interesting disease in certain stages of its development, and are failing to recognize it in its entirety because of the multiplicity of symptoms. For this reason, and because one of the three cases reported here is complete, I am presenting some review of the subject.

While I am fully aware that the disease is not confined strictly to the genitourinary organs, it holds one's interest because of its diversified symptoms and contradictory manifestations. For instance, it is questionable whether, were it not for the renal pathology and blood chemistry, the roentgenologist could differentiate the bone changes from those of ordinary rickets; consequently ordinary dwarfism is often confounded with it.

On account of polyuria and polydypsia, it has been mistaken for diabetes insipidus. Only the terminal stages of renal rickets may show hypertension, arteriosclerosis, signs of uremia, convulsions, edema, failing mentality, and coma. Yet we find every condition which is supposed to enter into the production of these symptoms, namely, a low and fixed urine concentration, high blood protein, low blood calcium with high blood phosphorus, acidosis, and a urine containing albumin with hyaline casts.

I feel certain that there is an acquired type of renal rickets, the cause of which, if not relieved, results in bone changes. Also, there certainly must be a greater number of children suffering from this condition than the few reports in the literature would indicate. The acquired type is often the result of obstructions anywhere below the kidney pelvis. Early cases do not have all the cardinal signs, which are manifest in

* Read before the Section of Genito-Urinary Surgery, New York Academy of Medicine, Feb. 17, 1937.

the child who has reached the advanced stage of the rachitic; we often prevent the advance to the later stage by relieving the cause without perhaps realizing that such a disease process was in progress. Mitchell[8] in his most complete review of the literature, mentions congenital dilatation of the urinary passages as a cause, as well as acquired postnatal obstruction. Two of my three cases were secondary to the congenital type of urinary obstruction.

Fig. 1. J. S. at the age of 19.

Fig. 2. J. S., compared with a normal boy of the same age.

The diagnosis of renal rickets is based on the following findings:

1. *General Appearance.* This usually conforms to a certain type. The skin is dry and often pigmented a dirty yellow. The hair of the head is coarse and brittle, and if the child has reached the age of adolescence, the pubic hair is thin but coarse, with a well defined line of demarcation. The face is wrinkled and expressionless, resembling that of a Mongolian idiot. These, together with characteristic leg deformities and changes which come with lack of sex development, give a dwarfish appearance. (Figs. 1, 2 and 3.)

2. *Bone Changes.* As a rule these first attract the parents' as well as the physician's attention. The child develops either a genu valgum or a genu varum; confirmation is afforded by the *x*-ray findings. According to the roentgenologist, the changes are about the epiphyseal areas. There is a greater translucency and a more spongy appearance in the bones of the renal rachitic than in the child with ordinary rickets. The skull picture is characteristic; it has been described by Parson[9] as having a woolly, stippled, or honey-

combed appearance, with great thickness. (Figs. 4, 5 and 6.) I was astounded at the ease with which the skull and the femur

Fig. 3. Pubic hair line of J. S. at the age of 19.

were amputated with the ordinary autopsy knife. According to both the roentgenologist, Dr. F. B. Stephenson, and the pathologist, Dr. E. I. Dobos, the skull shows marked thickening, with osteoporosis, and the long bones show faulty calcification (Figs. 7, 8 and 9), with softening at the epiphysis, resulting in the deformities. The sella turcica (Fig. 10) was 6 mm. deep, the minimum for the age, and was 9 mm. in its anteroposterior diameter. This is smaller than the average for the same age, which is 6 by 12 mm. (Fig. 11.)

3. *Blood Changes.* Normal children show a blood calcium of 9 to 11 mg., and phosphorus between 3.5 and 5 mg. per 100 c.c. In renal rickets this ratio changes, the phosphorus *increasing* and the calcium *decreasing*, the opposite of ordinary rickets. The cause of this reversal is one of the much discussed questions of the disease, for, as is well known, there seems to be throughout life a constant attempt to maintain a certain normal balance between the amounts of calcium and phosphorus in the body. In renal rickets, as in all true nephritides, we find a molecular retention, and it is well known that the larger the molecule, the quicker and greater will be

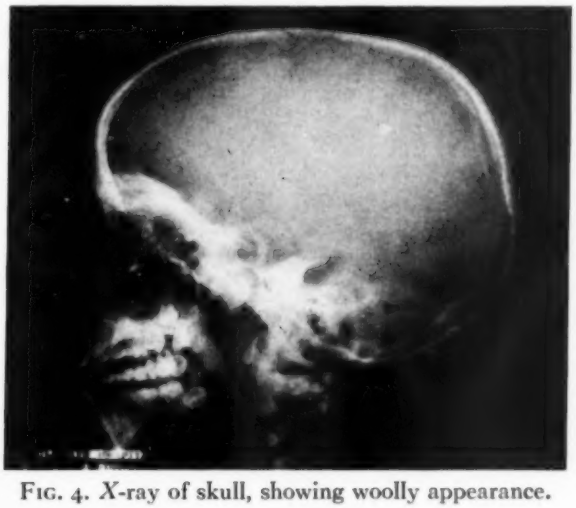

Fig. 4. *X*-ray of skull, showing woolly appearance.

the retention of the substance which that particular molecule goes to make up.

According to the theory advanced by Mitchell[8] when the kidney begins retaining phosphorus, this substance seeks the bowels as a means of elimination. As it enters the alimentary tract it immediately comes in contact with the food calcium, and, unfortunately for the patient, an insoluble calcium phosphate is formed. This prevents calcium from entering the blood stream, and causes a serious calcium depletion. The necessary calcium must be obtained from some source, and since the exogenous calcium is not available because of its combination with phosphorus for elimination via the colon, bone calcium is drafted for use. The loss of calcium from the bones results in the bone changes so graphically shown in the autopsy findings.

Reports of cases in which bone changes occur have made very little mention of parathyroid findings. Julian D. Boyd,[2] in a report on clinical hyperparathyroidism with the citation of a case, makes the following statement: "It would be easy to make a diagnosis of renal rickets in a patient with bone changes such as are found in this condition, together with such urinary abnormalities. However, the two

conditions can be clearly differentiated by the determination of serum, calcium and phosphorus. In renal rickets, the calcium is lowered and the phosphorus increased, while in hyperparathyroidism, the reverse is true." As I have stated, this is a disease of contradictions, for in our reported case the parathyroids are shown to be markedly increased in size (Fig. 12), while at the same time there was an increase of the blood phosphorus to 11.3 mg., with a calcium reading of 9.4 mg. I suspect that all patients of this type, with bone changes, who live any length of time, have an increase in the size of the parathyroids. Where these glands do not show a hyperplasia, there are no bone changes complicating the nephritis; the case should then be classed as one of uncomplicated chronic interstitial nephritis, a condition always ending in an early death. The mere fact that bone changes do occur shows that this type of rickets is due to a hyperplasia of the parathyroids. (Fig. 13.) It is their hyperactivity which mobilizes the bone calcium, thus in order to maintain keeping

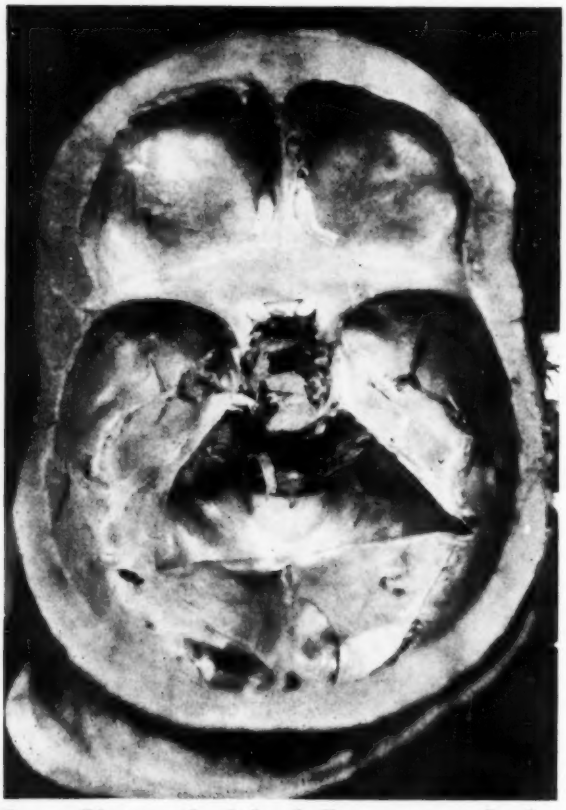

Fig. 5. Photograph of the skull at autopsy, showing the extreme thickness.

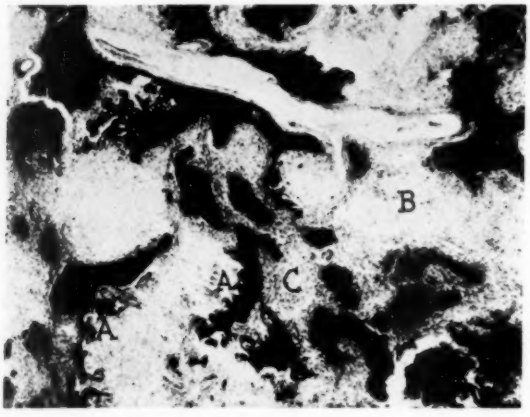

Fig. 6. Photomicrograph from skull, showing bone changes. A, multinucleated osteoclasts in Howship's lacunae. B, fibrous marrow tissue. C, numerous newly formed trabeculae.

Fig. 7. Bony deformities of the knees.

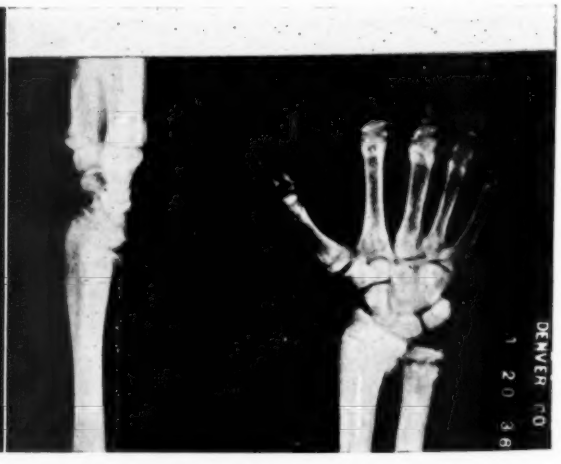

Fig. 8. Deformities of the wrist joint.

up a sufficient amount of blood serum calcium to prevent, as long as possible, uremic convulsions, which certainly should occur early in the disease, as there is a marked protein retention as well as an acidosis.

Edward L. Compere[3] states: "In the adult as well as in the child, the bone salts are continually removed and renewed, so that there is a constant flow of both calcium and phosphorus away from bone into body fluids, and a redeposition of similar salts which have been absorbed from the intestinal tract. The ratio must be constant if perfect health is to be obtained."

4. *Sex Development.* A lack of sex development at the age of puberty is a characteristic phenomenon in every case. On this account the hormones have been implicated. In this condition, as in other kidney lesions of childhood, lack of sex development is found, but in none of the autopsy protocols of renal rickets have I been able to find reports of sections of either testicles or ovaries, though all writers mention them as undeveloped. Of course, the simplest explanation would be to include the undeveloped sex glands as part of the general picture of dwarfism, but it would be a great deal more plausible were we to ascribe the dwarfism to the inactivity of the sex hormones, in spite of the fact that Hurtz was unable to find any endocrine changes. Figure 14 shows the testicle in our case, and according to the pathologist, there was a total absence of cytogenesis. The lumen of the acini is partially or completely obliterated, and the interstitial cells of Leydig greatly decreased in number. Nevertheless, this patient at the time of his death was twenty years of age. Can the tubular portion of this testicle produce that glamorous hormone (inhibin), the absence of which allows the anterior pituitary lobe free sway? The testicles as a whole appear distinctly smaller than usual, and upon weighing those of our patient, they were found to be only 13.5 Gm. each. The epididymis is essentially negative.

5. *Renal Changes.* It is here that the real diagnosis is made. Up to the present, knowledge of these changes is based only on autopsy reports, which in the final analysis are unquestionably the most accurate. Microscopically, there are sclerotic changes in the interstitial tissue, which before death affect the majority of the tubules and glomeruli. Those tubules which are active show a very large lumen due to one of two conditions, a dilatation from back pressure or a compensatory hypertrophy.

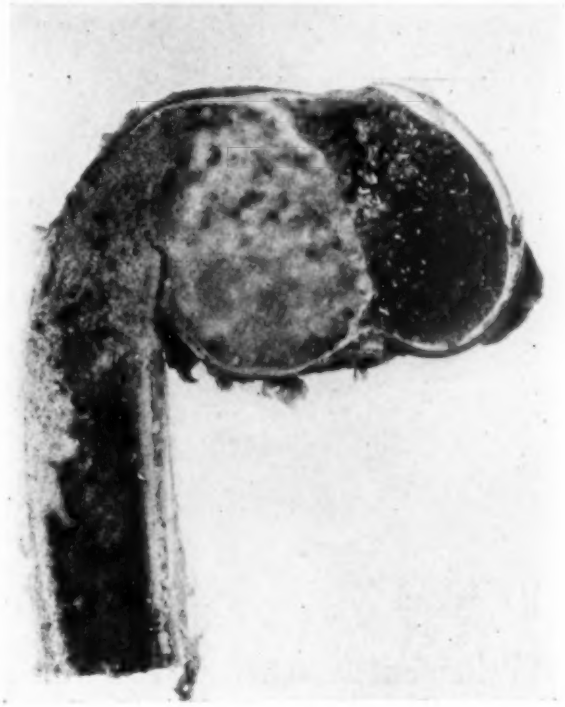

Fig. 9. Autopsy sections through knees, showing faulty calcification with softening at the epiphysis.

Dr. George B. Bader of New York[1] gave an accurate description of these renal changes. The interesting feature about the glomeruli that are left is that they show what appears to be hyperplasia, as though they had made an extra attempt to carry on the work after the interstitial changes had destroyed the majority. Hyalinization has taken place in numerous other glomeruli with lymphoid deposits. Bowman's space in some instances seems as though it had become dilated, making one think that in

its attempt to excrete urine through the tubular system which had become partially blocked by connective tissue, back pressure had occurred, producing this condition. (Shall we coin a word and call it hydrobowmanosis?) Something like this must have taken place in many of the glomeruli in which hyalinization followed.

The scarcity of renal blood vessel pathology is of interest and offers the only plausible reason for the low blood-pressure which is so characteristic in these patients. Throughout the entire kidney, calcium is deposited, but it is confined to the interstitial tissue, the tubules escaping and the arteries showing very little change. Again the disease is one of paradoxes, for in other parts of the body the arteries show marked calcium deposits. Several case reports have mentioned renal calculi, but have not designated the location of the stones. (Figs. 15 and 16.)

This type of kidney conceivably is produced by two causes, i.e., either congenital, or acquired. To say what produces the congenital type would be to deal only with theories. The acquired type is described more often than any other, and yet some authors do not realize that they are dealing with *interstitial* changes in the kidney produced by lower tract pathology. Relief from lower tract pathology by urologic maneuvers is the only hope for these sufferers.

Fig. 10. Sella turcica of J. S. Dimensions 6 by 9 mm.

Fig. 11. Normal sella turcica. Dimensions 6 by 12 mm.

The first case I am reporting is of the congenital type, for which I am indebted to Dr. Roy P. Forbes.[4] The other two patients came under my observation, but it was Dr. Atha Thomas,[11] an orthopedist, to whom I referred one of these patients on account of a genu valgum, who made the diagnosis. In the case of Dr. Forbes, the diagnosis was complete with the exception of the genitourinary findings, and later, the autopsy report. I was requested to see the patient to examine the renal tract. The following case history was obtained from the records of the Children's Hospital, where the patient had been under observation at varying intervals for the preceding four years.

CASE REPORT

J. S., age 16 years, was seen in September 1933, with a diagnosis of renal rickets.

His father was 6 feet tall, and weighed 225 pounds. His mother, brothers, and sisters were of average size. There had been no miscarriages, and there was no history of lues in father or mother; no history of any chronic familial diseases.

The patient was a full term baby, delivered normally, with a weight of 6 pounds at birth. He had been breast fed until one year of age. Beginning at six months, orange juice ½ to 1 ounce daily and lime water were given. Shortly afterward, egg, cereal, and green vegetables were added. At one year, Eagle Brand milk was given, but no cod liver oil was taken until two years of age. The patient lived on a farm in Missouri, and had abundant exposure to sunshine. However, from a birth weight of 6 pounds, he gained only 6 additional pounds in two years. *The skin has always had a bronze color.* His first tooth erupted at six months. The fontanelle closed at the age of one year, according to his mother. She noticed no bony changes in skull or ribs, but the lower legs were bowed, due to softness of bones (genu varum). The patient began walking at 1½ years, but owing to extreme bowing of legs, wore braces for support. Later, he developed knock-knees (genu valgum). He began school at the age of 6, but his mother considered him backward in comparison with other children, and at the age of 15, he finally reached the eighth grade. He was out of school at the age of 6 because of a fracture of the right leg (cause of this fracture was not given). Diseases and injuries include scarlet fever at 5, with no follow-up urinalysis; compound fracture of right tibia at age of 6, which became infected and bone was scraped one year later; only recently a small amount of drainage recurred; appendectomy at 14.

Present Illness. Mother presented the child at Children's Hospital on the advice of the physician who had treated the old infection of the leg. The chief complaint was that the child had failed to grow and develop normally, that his bones were soft, necessitating braces for support. There was no history of growing pains. The *symptoms* reported were moderate frequency and polyuria; moderate polydipsia; no headaches; occasional vomiting and distention relieved by fruit juices and soda water; no convulsions; no tetany; slight edema of the ankles at times; no hemorrhage tendency; no visual disturbance; no palpitation.

Fig. 12. Autopsy specimen of parathyroids, greatly enlarged.

Physical Examination. The patient was a poorly nourished, poorly developed white male, apparently about 12 years of age, though his real age was 16, lying quietly in bed with no apparent distress. His voice was of a childlike quality. His skin was loose, dry, and of a sallow, dirty, bronzed appearance. The scalp was clean, with a normal growth of brown hair, coarse in texture. The skull was symmetrical, but the prominent *parietal* bones made it appear large in relation to the rest of the body. His facial expression was vacant, and his features definitely mongoloid. The ears were negative. The pupils reacted normally, with normal fundi and muscle balance. There was no obstruction to breathing, and the buccal mucous membrane was normal. The teeth, small in size, were stained a dirty yellow. The tonsils were somewhat enlarged, giving evidence

of chronic inflammation, but no adenopathy was present. The patient was markedly pigeon-chested. No Harrison groove was noted; the percussion note was resonant, and the breath sounds clear. No apparent enlargement of the heart was noted, and the sounds were of good quality. A tendency to pot belly with slight distention was present, but no tenderness was elicited and no organs were palpable. No scoliosis or kyphosis was observed.

The extremities were poorly developed, the joints prominent, but without tenderness. There was a marked exterior bowing of both femurs, most pronounced in lower third, with mild genu valgum and marked genu recurvatum, subluxation of both knee joints, and valgus deformity of both ankles. The genitalia were small in size; no pubic or axillary hair was present. The reflexes were within normal limits.

Laboratory Findings. The urine was acid, with a specific gravity of 1.003, a trace of albumin. Sugar and acetone were absent; no casts were noted; there were few white cells and no red cells. The Mosenthal kidney function test showed fixation to 1.004 and 1.007. The blood hemoglobin was 45 per cent; R. B. C., 2,250,000; W. B. C. 6,400; 62 per cent polymorphonuclears; 38 per cent lymphocytes.

The basal metabolic rate was plus 3 per cent.

Blood chemistry showed N. P. N. 109 mg. per cent; creatinine 4 mg.; phosphorus 6 mg.; calcium 10.5 mg.

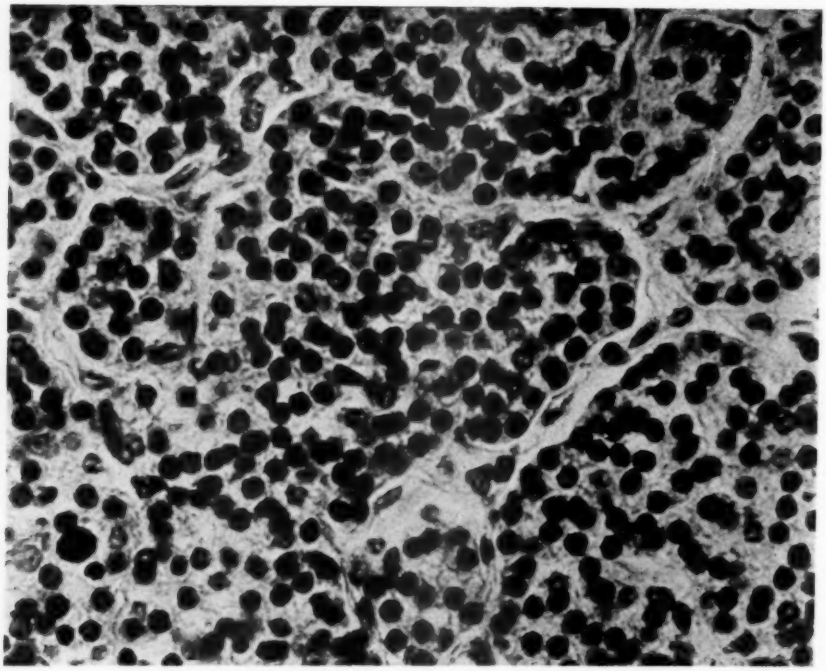

Fig. 13. Photomicrograph of parathyroid, showing marked hyperplasia.

The blood Wasserman was negative.

Psychological Examination. I. Q. was 55 on the Binet test and 60 on the Otis.

Roentgenologic Examination. *X*-ray of skull showed the sella turcica to be slightly smaller than normal for a child of this age. Tibia and fibula showed some cupping of the lower epiphysis of each leg, having the appearance of an old rachitic condition. Some irregularity of outline appeared at the lower epiphysis of each ulna and radius, with some cupping, suggestive of rachitic change. In November 1933, *x*-rays of the hands showed slightly increased recalcification of the lower epiphysis of the ulna and radius, representing a slight improvement over last examination.

In June 1934, a second laboratory examination disclosed that the urine was neutral, with a specific gravity of 1.006; albumin 2 plus; sugar and acetone negative. An occasional pus cell was present. The blood hemoglobin was 50 per cent; R. B. C. 3,000,000; W. B. C. 6,600; 67 per cent polymorphonuclears; 31 per cent lymphocytes; 2 per cent eosinophiles.

Blood chemistry at this time gave the following results: N. P. N. 120 mg.; creatinine 12 mg.; calcium 9.4 mg.; phosphorus 11.3 mg.

(Certainly a most interesting blood chemistry, in the face of the improved blood counts.)

On August 1935 the urine was acid, with a specific gravity of 1.014, albumin 1 plus, and an occasional pus cell. Blood chemistry showed N. P. N. 100 mg.; creatinine 5.2 mg.; urea 45.0 mg.; calcium 9.0 mg.; phosphorus 7.0 mg.

In January 1936, the child was brought to the hospital because of recently occurring distention with vomiting. This had occurred sometimes after meals, but was relieved by either fruit juices or soda water. Between meals, distention was also induced by cold water. Physical examination showed no essen-

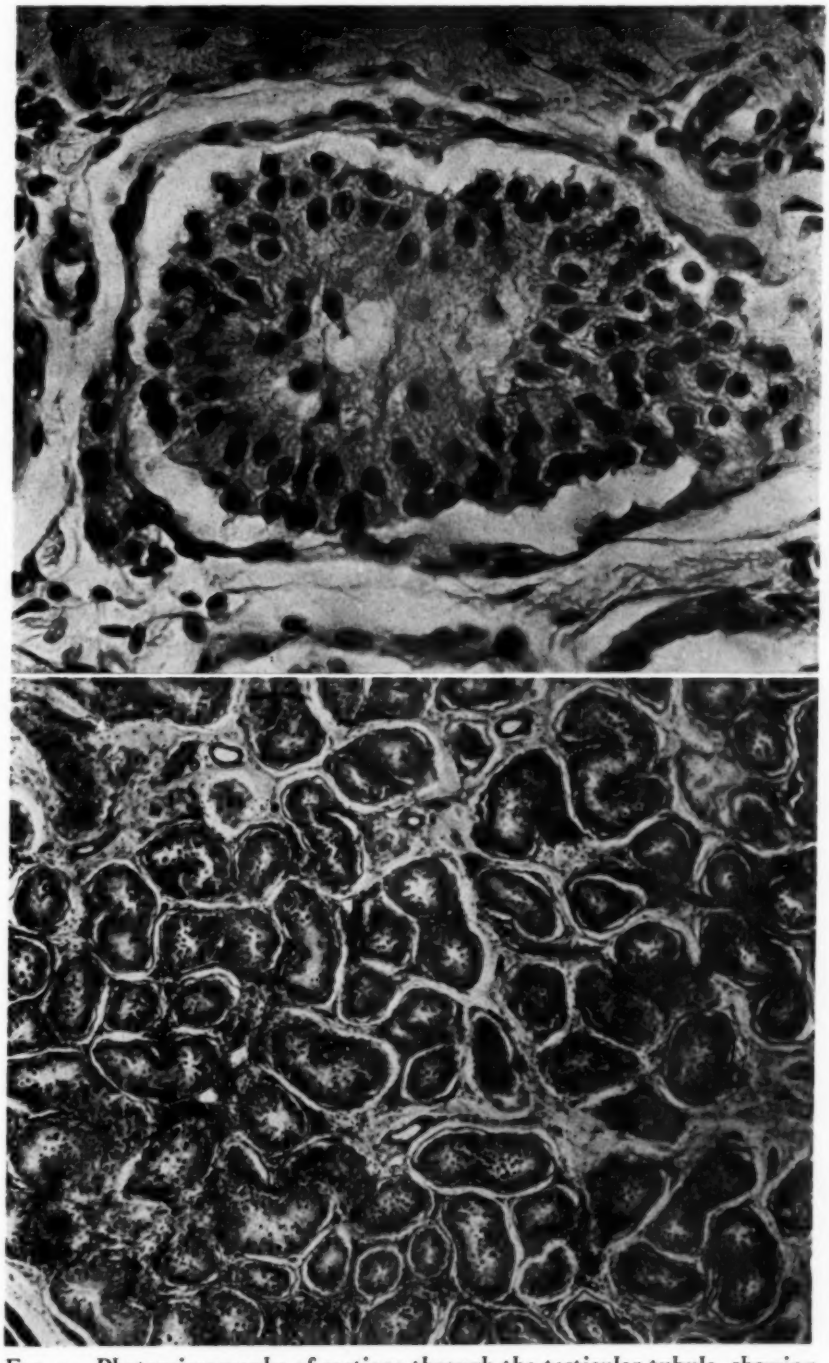

Fig. 14. Photomicrographs of sections through the testicular tubule, showing a total absence of cytogenesis.

tial change from the previous records. Blood chemistry was as follows: N. P. N. 110 mg.; creatinine 3.65 mg.; calcium 6.9 mg.; phosphorus 8.3 mg. The Mosenthal fixation test showed improvement, varying between 1.008 and 1.014.

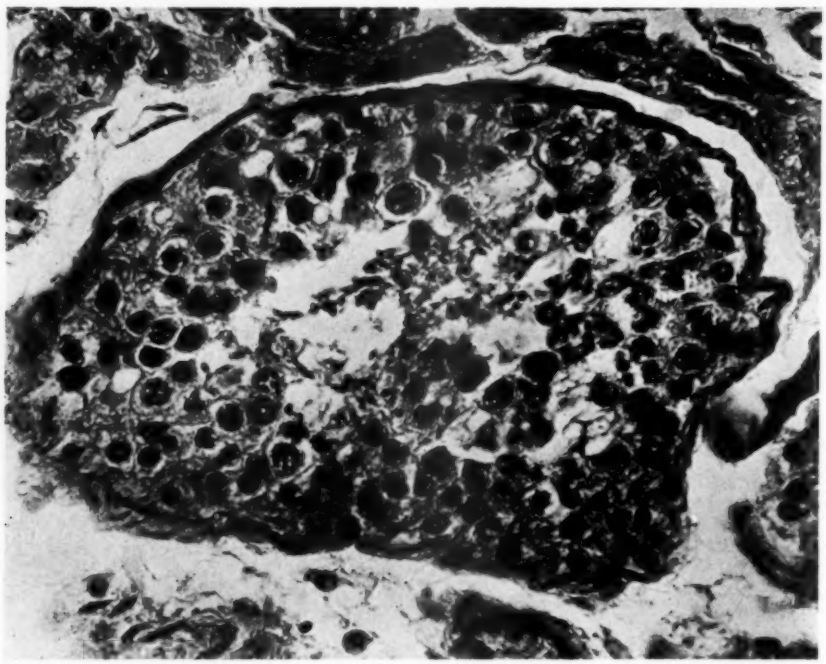

Fig. 14c. Photomicrographs of sections through the testicular tubule, showing a total absence of cytogenesis.

On February 28, 1936, the blood chemistry was: N. P. N. 172 mg.; urea nitrogen 53.2 mg.; creatinine 4.6 mg.; calcium 10.6 mg.; phosphorus 8.8 mg.; per 100 c.c. of blood.

On March 3, 1936, the CO_2 combining power of the blood plasma was 32. A complete eye examination was negative in every respect. The blood count was: hemoglobin 36 per cent; R. B. C. 2,500,000; W. B. C. 4,000; 65 per cent polymorphonuclears; 35 per cent. (Fig. 17.)

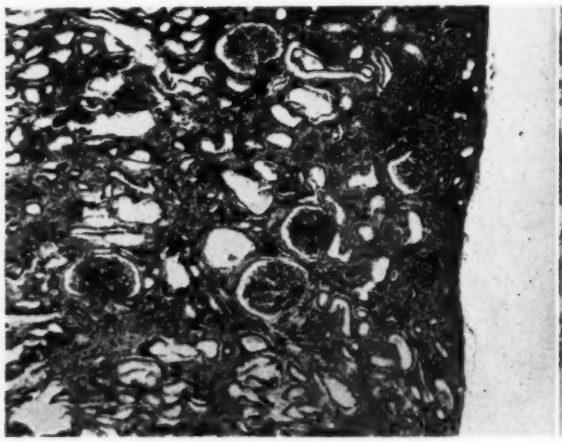

Fig. 15. Photomicrograph of kidneys, showing enormous dilatation of the tubular system with an increase in the size of the individual glomeruli.

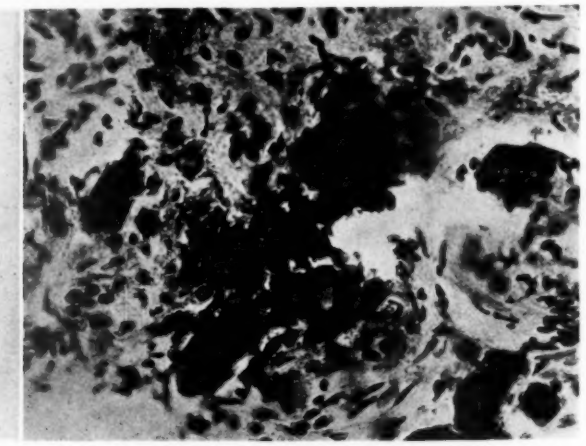

Fig. 16. Photomicrograph of kidney, showing calcified deposits in the interstitial tissue.

Course. I was called in consultation to see this patient January 26, 1936, at which time cystoscopy was done. A No. 21 F. Brown-Buerger cystoscope was passed without difficulty under a local anesthetic. The bladder was most interesting on inspection, as it gave one

the impression of a toneless sac. The mucosa was extremely pale. The ureteral openings were not dilated, but the orifice on the right was

	N.P.N.	Urea	Creatinin	Calcium	Phosphorus
Sept. '33	109	-	4.0	10.5	6.0
June '34	120	-	12.0	9.4	11.3
Aug. '35	58.5	-	2.7	8.7	7.0
Dec. '35	100	45	5.2	9.0	7.0
Jan. '36	100	-	3.6	6.9	8.3
Feb. '36	172	53.2	4.6	10.6	8.8

Mosenthal Fixation Sept. '33 1004 to 1007
Jan. '36 1008 to 1014

CO_2 Combining Power of Blood Plasma
March '36 32

Fig. 17. A few of the blood and urine findings in the case of J. S. from September 1933 to February 1936.

larger than normal. No. 5 radiographic catheters were introduced up to each kidney, the right meeting with obstruction about 2.5 cm. up, although the meatus on that side was the larger. After some manipulation, the obstruction was overcome and no further difficulty was encountered. Urines were collected from each side, urine from the left coming with more frequent and forceful drops than from the right.

Stereo-retrograde pyelograms were made, using neoiopax as shadow media. (Fig. 18.) The dimensions of these kidneys are measured on the films as follows: right, 8 cm. in length, 3 cm. in width; left, 7 cm. in length, 2.5 cm. in width. (Fig. 18A.) Compare these dimensions with those of a 6 months old infant, whose kidney measures 6 cm. in length and 3 cm. in width. (Fig. 19.)

Figure 20 is a cystogram made by using a 3.5 per cent solution of sodium iodide and filling the bladder until a sensation of fullness was complained of. This occurred after the introduction of 14 ounces of the solution. There is no regurgitation up either ureter.

From a urologic standpoint, it is inconceivable that kidneys of this size are capable of carrying on life at all in a person even half the patient's size. The only classification under which they can conceivably be placed would be that of congenital hypoplastic kidneys, for they appeared to be perfectly developed in shape, position and contour. The one on the right had no major calices, the minor calices springing directly from the kidney pelvis, as so often occurs in a hypoplasia of the kidney of congenital origin. The pelvis on the left showed no defect except that it was of miniature size, with but two well-defined major calices present. There was no deformity of the major calices,

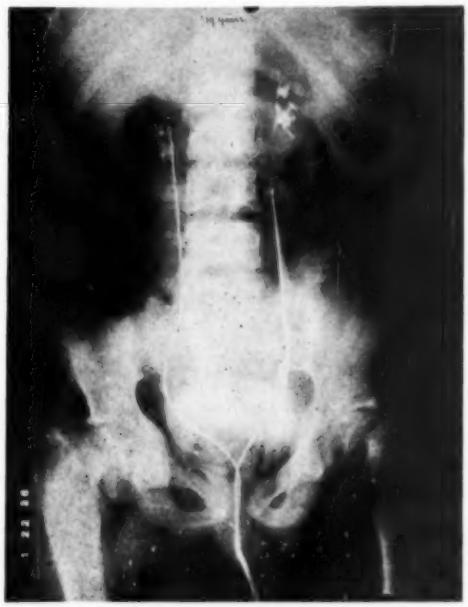

Fig. 18A. Pyelogram taken January 26, 1936.

yet it was apparent that they were not nearly so well developed as those of the 6 months old baby demonstrated.

The ureter on the right showed some dilatation, which was probably accounted for by the obstruction in the first 2.5 cm. of the ureter. (Fig. 21.) The urines collected from each kidney gave the same findings as the combined urines, except for an occasional pus cell from the left. There was only an occasional urine report which gave an acid reaction; yet the blood showed that the patient was in a state of acidosis.

The prostate felt by rectum, had two well-defined lateral lobes with a median sulcus, and to the examining finger there was diminished elasticity. A vigorous massage given to both vesicles and prostate failed to express the slightest secretion. The massage was done on a full bladder, filled with distilled water which was sent to the laboratory after it was voided. No spermatazoa or amylaceous bodies were found—in fact to the eye, the water was as clear as when introduced into the bladder. The scrotum was of the flabby type, seen often in old men, with very sluggish cremasteric reflexes. Both testicles were firm, but small and round, like those of a child of 3 to 4 years. I was able to define the epididymis, and there seemed

to be a slight amount of fluctuation on the head of the one on the right. The vasa were plainly palpable.

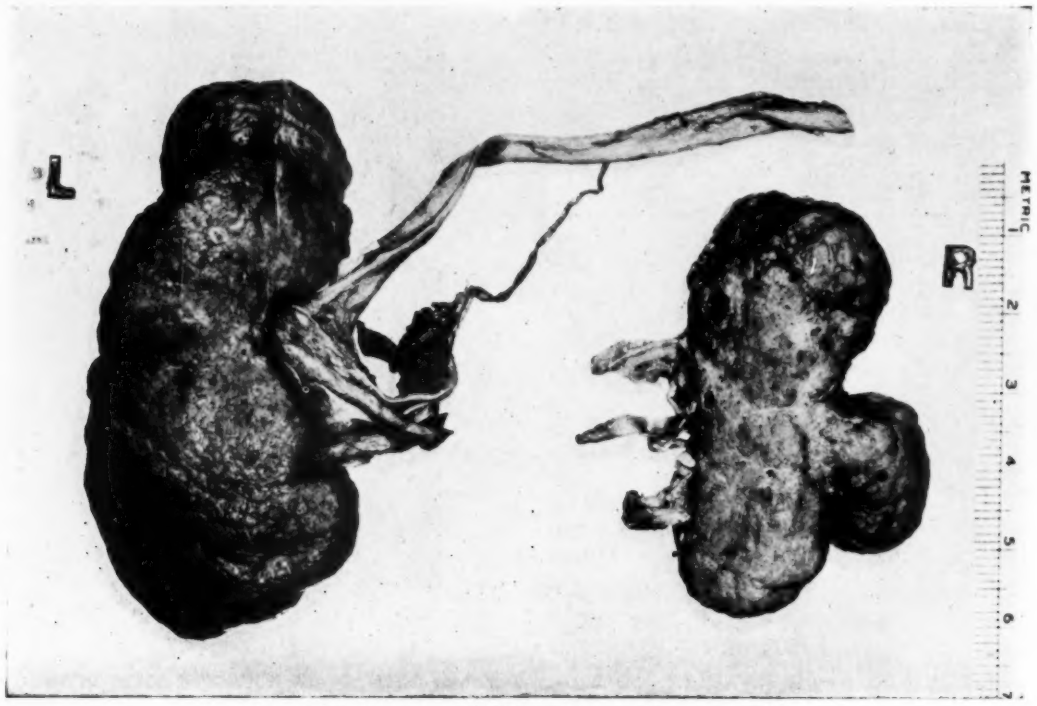

Fig. 18b. Autopsy of kidney, September 10, 1936.

On February 27, 1936, another cystoscopy was performed, for I was curious to see with a McCarthy panendoscope, the appearance of the prostatic urethra, and to reinspect the bladder. There were no notable changes in the bladder from the previous examination, but the ureters were very close to the bladder sphincter, which I find is usually the case when a patient has, as this one did, a well-defined collar neck obstruction, although no residual urine was demonstrable at either examination. The verumontanum was large and extremely pale; the openings of both ejaculatory ducts was easily visualized.

On March 2, 1936, I catheterized the left ejaculatory duct and injected 3 c.c. of neoiopax to see if atrophy of the seminal vesicles had occurred along with that of the testicles. The vesicle could be well filled, and the vas could be followed down to the external inguinal ring (Fig. 22), which proves that a failure of development of the testicle does not necessarily produce an atrophy of the vas and seminal vesicles.

As far as I am able to find, this is the only case of renal rickets that has ever had a complete cystoscopic examination, and certainly the only one in which the seminal vesicles have been *x*-rayed.

An intravenous dye of neoiopax, using 15 c.c., was given, and at the end of thirty minutes nothing had been excreted in sufficient quantity to give the shadow of either kidney, pelvis, ureter, or bladder. Figure 23 was taken during this period to demonstrate this, and brought out a most interesting finding, namely, calcification of the internal iliac arteries on both sides. This calcification has been mentioned by several writers on the subject, but always as an autopsy finding. To me it is hard to explain why there should be calcification in these arteries and decalcification in the bones. One would think that with the blood so deficient in calcium, the substance would be drawn from any source possible; yet these arteries have every appearance of deposits of calcium salts in their walls. This was later checked at the autopsy. The changes in the bony pelvis (Fig. 23) are also typical of those of renal rickets.

The adrenals may play a more important rôle than has hitherto been ascribed to them. Dr. Dobos describes a fatty infiltration of the cortex, with the medullary substance essentially negative. (Fig. 24.) As the cortex is the principal secretory portion of the gland, this

fatty change could interfere with the physiologic function, even to the extent of causing the pigmentation in the skin.

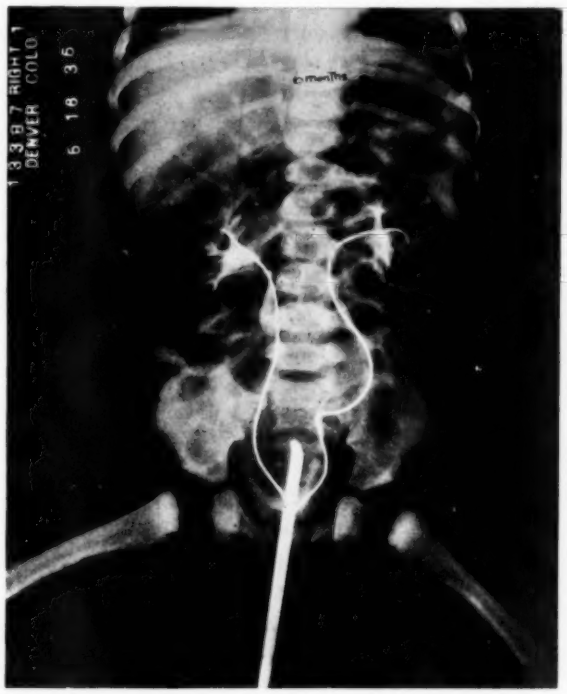

Fig. 19. Pyelogram of a 6 months old infant. Compare this with that of the 19 year old patient.

This patient entered the hospital (walked in) for the last time on August 6, 1936, and the following is taken from the hospital record:

"This patient, who has been in the hospital repeatedly over a four-year period, entered because of vomiting. He had not been able to retain fluids for twenty-four hours. A blood examination revealed: N. P. N. 300 mg.; creatinine 4.9 mg.; calcium 9 mg.; phosphorus 10.2 mg.; chlorides 412; with a blood *pH* of 6.95. Physical examination was apparently the same as on previous examinations, except that the deformities were more marked."

The patient did well for about two days. He then developed a severe stomatitis. The nasal cavity and tongue looked as if they were covered with a leukoplakia. The blood-pressure remained about 110/40. The eyegrounds were normal. The patient refused feedings, and vomited continuously. Intravenous fluids, Hartman's and glucose, and a blood transfusion were given. The patient then complained of inability to move his left arm and leg, but no paralysis or weakness was noted on physical examination. The course was steadily downhill. The young man became mentally torpid. The last two days his fingers became cyanotic and the heart tones poor. Despite stimulation, he expired September 10, 1936.

Fig. 20. Cystogram of J. S., using 3.5 sodium iodide.

Figure 25 shows other blood examinations during this last illness. On several occasions the specific gravity of the urine was between 1.012 and 1.018, which seems incredible when one considers the kidney drainage. The vomiting, however, could account for this concentration.

Autopsy. The autopsy findings were recorded by the pathologist, Dr. E. I. Dobos, who also prepared the material from which the illustrations were made.

Autopsy Protocol

Name: J. S.	Case No. 22439
Age: 19 years	Autopsy held at Children's Hospital, September 10, 1936.
Attending Physician: Dr. R. Forbes	
Prosector: Dr. E. I. Dobos	Present at Autopsy: Drs. Forbes, Howard, McGraw, Verploeg, and House Staff.

The body is that of a poorly developed and very poorly nourished white male child 135 cm. in length. The head appears to be enlarged and out of proportion to the rest of the body. The skin shows marked brownish color which appears to be fairly generalized. However, there are numerous areas of varying size where the skin appears to be bleached. The general

appearance of the skin closely resembles the bronze color of Addison's disease. The subcutaneous tissue has lost the greatest portion

FIG. 21. *X*-ray of right kidney, showing no major calices.

of the fat content, and the skin may be lifted up in extremely thin folds. The skeletal changes are extensive. There is a marked deformity of the spine which appears to be a kyphoscoliosis, with possibly a lordotic curve in the thoracic region. The bony wall of the chest shows a marked lateral compression on both sides causing a prominence of the sternum —thus somewhat approximating the shape of a pigeon chest. At the junction of the osseous and cartilaginous portion of the ribs on both sides, prominent swelling is noted on all ribs. The comparative measurements are: anteroposterior diameter of the bone portion of the ribs, 7 mm.; anteroposterior diameter of the cartilaginous portion of the ribs, 6 mm.; anteroposterior diameter at the osteochondral junction, 16 mm. The pelvic frame appears to be usual in configuration. Upon examination of the lower extremities, a marked genu valgum is noted.

Upon opening the chest, approximately 40 c.c. of straw-colored, clear fluid is encountered on both sides of the pleural cavities. A few firm, callous adhesions are encountered on both sides of the pleural cavity. Otherwise, the pleural surfaces are essentially negative. The lung parenchyma is rusty brownish in color, shows no areas of consolidation or atelectasis, and on the cut surface a considerable amount of straw-colored, clear fluid empties on pressure from the alveolar spaces. The pericardial sac contains the usual amount of straw-colored, clear fluid. The heart is moderately enlarged, and the enlargement is chiefly due to dilatation rather than hypertrophy. The measurements of the myocardium are: left ventricular myocardium, 11 mm.; right ventricular myocardium, 3.5 mm. The myocardium is soft and flabby throughout and appears grayish in color. Examination of the mural and valvular endocardium fails to disclose significant anatomic changes. Upon examination of the large vessels, several disseminated atheromatous plaques are found just above the sinus of Valsalva which entirely disappears in the ascending portion and in the arch of the aorta. No atheromatous changes are found in the pulmonary artery or in the coronary vessels. The structures of the posterior mediastinum are essentially negative. The peribronchial and hilus lymphnodes show no evidence of enlargement and are usual in shape, color, and consistency. The thymus has almost completely disappeared. Upon removal of the upper respiratory passages, the entire larynx is dissected and removed. It shows no significant gross anatomic changes. The thyroid gland is somewhat asymmetric. The left lobe measures 40 mm. in length and 18 mm. in the anteroposterior diameter. The right lobe measures 46 mm. in length and 17 mm. in the anteroposterior diameter. The isthmus is broad. On the posterior aspect of the thyroid gland, two tumor masses are found on the left side, and one attached to the right lobe of the thyroid gland. All those tumor masses are in the anatomic location which corresponds with the usual site of the parathyroid glands. These tumor masses appear as encapsulated prominent structures attached to, but apparently independent of, the thyroid gland, and differing from the substance of the thyroid in color and consistency. The upper nodule attached to the left lobe is more globular in shape and measures 11 mm. in diameter, while the tumors attached to the lower pole of the thyroid gland, one on each side, are more elliptical in shape, measuring 15 mm. in length and 9 mm. in thickness. The weight of these nodules is *estimated* as follows (I feel sure this estimate is too low): left upper nodule, .67 Gm.; left lower nodule, 1.02 Gm.; right nodule, .74 Gm.

The gastrointestinal tract is removed, opened, and examined, but outside of a moderate injection of the lower part of the ileum and of the cecum, no noteworthy changes are enountered. The spleen is moderately enlarged. The capsule is smooth and glistening, and on cross section reveals a preponderance of connective tissue; very little scraping is obtainable. The weight is 119 Gm. The liver is usual in size, shape, and appearance, and on cross section shows no noteworthy changes. The pancreas is somewhat smaller than usual, is firm and hard in consistency, but no other changes are observed. Upon the removal of the kidneys, both are found to be considerably smaller than usual. The left kidney weighs 38 Gm. and the right kidney 22 Gm. The capsule is stripped off easily and underneath the capsule the cortical surface is finely granular in appearance and contains numerous small cysts containing straw-colored, clear fluid. The average diameter of these cysts is 2 mm. On cross section, several small calcareous masses are encountered. The entire kidney substance is profoundly fibrosed, and the markings have almost entirely disappeared. The pyramids are not recognizable, and the boundaries between the medullary substance and cortex are indistinct. The calices and kidney pelves are essentially negative. Both adrenals appear to be greatly enlarged, weighing 14 Gm. each. The spermatic cord, epididymis, and testes are removed. The testes appear distinctly smaller than usual, weighing 13.5 Gm. each.

Fig. 22. Injection of the left seminal vesicle and left vas, showing normality of both.

Fig. 23. Calcification of the internal iliac arteries on both sides. Note also the pelvic bone changes.

Examination of the thoracic and abdominal aorta discloses small atheromatous plaques around the orifices of the intercostal arteries. At the bifurcation of the iliac arteries, numerous atheromatous ulcerations and calcareous deposits are found. Gross examination of the skeletal bones reveals a generalized softening which attains such a degree that all bones, with the exception of the shafts of the long bones, can be easily cut with a knife. Such changes are particularly pronounced in the vertebrae, in the epiphyseal ends of the long bones, and in the cranial vault. The frontal bone in the midline between the two orbital spaces measures 12.5 mm. in diameter, and its consistency is such that it can easily be cut with a razor blade. The flat bones, the epiphyseal ends of the long bones, as well as the shafts, show a large amount of fat accumulation, which is indicated by the yellowish discoloration of these areas. The distal end of the femur shows such softening of the bony structure that the axis of the epiphyseal end forms a 90 degree angle with the

axis of the shaft. On cross section, it appears that the metaphyseal disc is enormously thickened, attaining a thickness of 39 mm.; and in contrast to the fatty infiltration of the epiphysis and diaphysis, this metaphyseal disc is composed almost entirely of hyalinous cartilage tissue through which narrow strands of bony tissue are woven through. The articulation surfaces and synovial membrane appear to be as usual. Bone changes similar to those described in the femur are observed in the other long bones.

	Aug. 26	Aug. 31	Sept. 2
N.P.N.	300.0	300.0	300.0
Creatinin	4.9	6.1	--
Calcium	9.0	--	--
Phosphorus	10.2	6.95	--
Chloride	--	412.5	--

Fig. 25. Blood findings in the case of J. S. a few days before death.

Upon opening the cranial vault, the brain and meninges are exposed. Upon the removal of those organs, no significant anatomic changes are encountered. The pituitary gland is somewhat smaller than usual. It weighs 0.4 Gm.

Microscopic Examination. Bone. Examination of the skeletal bones shows extensive fibrous tissue replacement of the bony structures. In the fibrous tissue, there are disseminated areas where osteoblasts are present, indicating some degree of new bone formation, while the bone trabeculae show extensive fragmentation and depletion of calcium. It should be emphasized, however, that no evidence of excessive numbers of osteoblasts is found in any place in the sectioned area. Besides the connective tissue, large amounts of adipose tissue deposits are found, especially in the epiphyseal ends of the long bones, as well as in the medullary canal. The metaphysis is composed chiefly of hyalinous cartilage tissue containing small bone trabeculae. The periosteum shows a diffuse fibrous thickening.

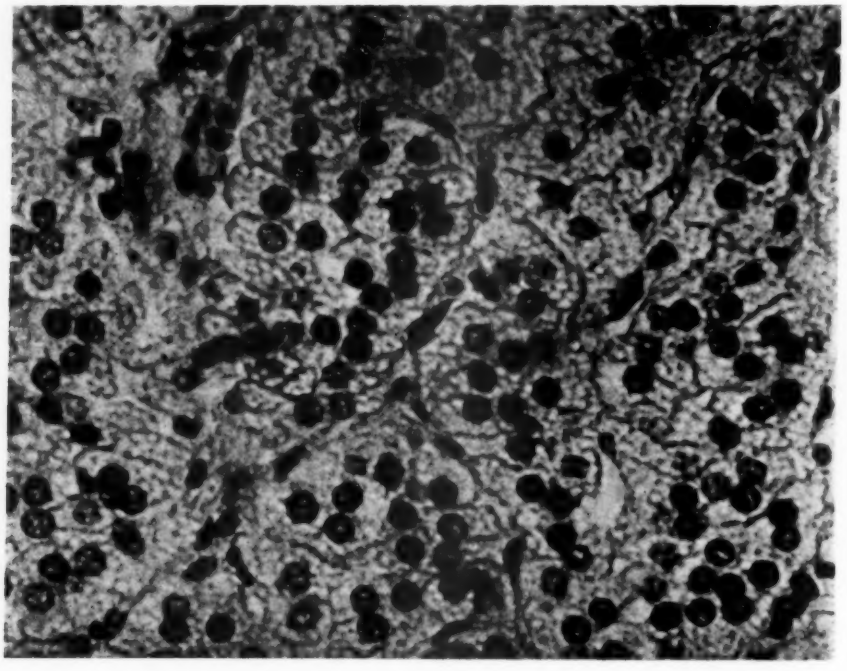

Fig. 24. Photomicrograph of the suprarenal gland, showing marked fatty degeneration.

Kidneys. Throughout the entire kidney substance, medullary as well as cortical, profound connective tissue proliferation is encountered. There are several areas of various sizes where the connective tissue undergoes calcareous changes; there are definite evidences of calcareous deposits in some of the larger vessels, and calcium deposits in the interstitial stroma. The glomeruli show asphyxiation, and part of the uriniferous tubes are compressed and obliterated, while others are greatly distended,

attaining a diameter many times the usual size. In the vicinity of the surface, the cortical substance shows numerous foci of round cell infiltration, which occasionally are perivascular, while in other places disseminated in the interstitial stroma, there are marked degenerative changes in the tubular epithelium.

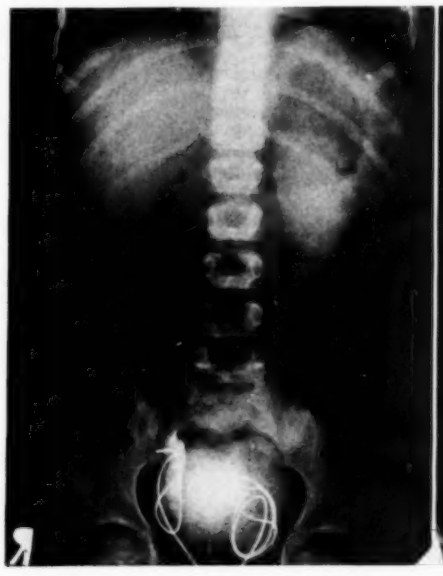

Fig. 26. J. M. (Case 11). Ureteropyelogram, showing catheters coiled in dilated ureters, with a large hydronephrosis of the left kidney pelvis.

Fig. 27. Cystogram of same patient, showing a regurgitation of the dye to each kidney.

Coronary Artery. Extensive atheromatous and calcareous changes are found in the second layer of the intima, accompanied by ulcerations in the first layer.

Testes. While the apparatus of spermatogenesis is well developed, no evidences of actual cytogenesis can be observed. The lumina of most of the acini are partially or completely obliterated, and the Leydig interstitial cells are greatly decreased in number. The epididymis is essentially negative.

Thyroid Gland. The acini are unusually large and are filled with excessive colloid material. The interstitial stroma is scant, and the blood supply is usual. The glandular epithelium is single layer cuboid epithelium.

Parathyroids. Microscopic examination of the parathyroid reveals dense cellular structure of lobular arrangement. The lobules vary in size considerably and are separated from each other by narrow strands of connective tissue fibers. This lobular arrangement is more pronounced on the peripheral portion of the gland, and toward the center portion the cellular structure becomes more confluent. The intercellular stroma is rather insignificant throughout the entire sectioned area. Among the cells, it was noted that the eosinophile cells are strikingly few in number. However, close examination reveals slight eosinophile character in a fairly large number of the cells, but inasmuch as the morphologic character does not comply with that of the usual eosinophile cells of the parathyroid, they cannot be considered as such. The cells are uniform in shape, size and appearance and show no evidence of adenomatous or malignant changes. The diagnosis is hyperplasia of the parathyroids.

Adrenal. The adrenal cortex shows considerable fatty infiltration especially of the glomerular and the fascicular layers. At the junction of the medullary and cortical substances, several round cell deposits are observed. The medullary substance is essentially negative.

Myocardium. The myocardium shows no fragmentation of the muscle fibers, but there is a marked enlargement and thickening of the sarcoplasm. The striation is also disturbed.

Pancreas. Essentially negative.

I wish to reiterate that, in my opinion, this case represents the congenital type of rickets, for every indication points to the

fact that practically from birth, this child had all the criteria that go to make up renal rickets or renal dwarfism.

Fig. 28. J. M. Regurgitation to the right kidney after a suprapubic drainage.

Fig. 29. *X*-ray of left knee in same patient, demonstrating early epiphyseal deformity.

Case 11. The next case is one of the acquired type of renal rickets, and the history leads one to believe the causes for the bone changes were of longer standing than the subsequent findings would indicate.

CASE HISTORY

J. M., age 11 years, male, of Saratoga, Wyoming was first seen in my office on August 20, 1931. His family history was negative, except that the mother had a right renal calculus. One sister is living and well, and one brother was born prematurely.

Past History. The mother stated that since the age of two, the patient had had trouble in voiding, and at times would roll in agony on the floor while attempting to urinate. As long as she could remember, the urine had contained pus and had had a foul odor. At the age of four, the boy developed a right inguinal hernia, for which he was operated on, and strange to say, the operation held despite the fact that he had to strain with each voiding. He had had measles one year previously, but no other illnesses. There was no disturbance of gait; the child had been able to run up and down stairs without difficulty, played and fished with other boys his age. He was in the sixth grade at school and very bright. His greatest weight had been one year before (65 pounds). He had always been constipated.

Present Illness. The patient had come in because of increasing difficulty in voiding, and persistent pus in the urine. He had no nocturia, but upon arising in the morning, passed large quantities of urine with difficulty. He had never complained of pain over either kidney. On August 21, 1931, at Mercy Hospital, a cystoscopic examination was done under gas, using a No. 12 cystoscope. The bladder neck was definitely constricted, inelastic, and fibrous in character. The bladder itself showed cellules and each ureteral opening was gaping widely, typical of a congenital bladder neck obstruction in which the valves of each ureteral opening had been destroyed from back pressure. A No. 4 catheter was passed up to each ureter. Figure 26 shows the catheters curled in the lower ureters; the injection of uroselectan failed to give a satisfactory picture of the pelves of the kidneys because most of it

regurgitated into the bladder. Urine collected from each kidney contained only an occasional pus cell. The voided bladder urine had a specific gravity of 1.009, was acid in reaction, had a trace of albumin, but no sugar, acetone, or casts. There were many pus cells and many red cells.

Blood chemistry showed N.P.N. 90 mg.; urea 50 mg.; creatinine 3.7 mg. sugar 100 mg., per 100 c.c. No blood phosphorus or calcium determinations were done.

The patient left the hospital the following day, but was readmitted sixteen days later. In the meantime, the blood chemistry had improved: N.P.N. was 50 mg.; urea nitrogen 30 mg.; creatinine 2.3 mg., per 100 c.c. Blood examination was as follows: white and red corpuscles were normal, hemoglobin was 75 per cent, and coagulation time two minutes.

The P. S. P. excretion was 33 per cent at the end of one hour, which I think is quite interesting when one considers the amount of destruction the kidneys have undergone, as shown in plates of ten days previously; yet we were unable to obtain a pyelogram with uroselectan intravenously. The patient was placed on a urethral catheter drainage which improved the kidney function still further, and on account of this improvement, I advised a bladder neck resection. The parents objected, however.

The patient left the hospital October 18, 1931, only to return six days later with a temperature of 103, the first that he had had. Blood chemistry was again bad. P. S. P. excretion at the end of the first half-hour was 3 per cent, and for the hour 10 per cent. A cystogram, taken on November 9, 1931, is shown in Figure 27. This demonstrates the regurgitation of the dye up the ureters. This *x*-ray plate also gives a very excellent picture of the pelvic bones, and the heads of the femurs, which according to the roentgenologist show no rachitic changes.

On November 13, 1931, the bladder was opened suprapubically and the fibrous neck was resected. The impression on palpating the bladder sphincter was that of an unyielding metal band. The punch, when cutting through it, made a sound as though it was of a cartilaginous material. The wound was closed around a Pezzar catheter, but the suprapubic opening had to be kept for constant drainage up to the time of the patient's death in the summer of 1936. Although when the tube was clamped off, his urinary stream was good, and he emptied his bladder, if this persisted for a few days, he would develop toxic symptoms.

Fig. 30. J. M. Changes in the bones of both wrists around the epiphyseal areas.

I judge that the mere act of voiding forced urine up the ureters into the kidney pelvis, for the ureterovesical valves never recovered their tone, as we demonstrated many times. (Fig. 28.)

Following this operation, his general condition improved, and on December 2, 1931, he left the hospital for his Wyoming home.

On August 3, 1933, a year and seven months after his operation, the patient was brought to the office by his mother, who stated he was having considerable distress on account of pains around the right knee joint, and because of this walking was painful as well as difficult. He was referred to one of the pediatricians for diagnosis, but the cause of the joint pain was not determined.

In June of 1934, almost a year later, the mother returned with him, stating that the condition had grown rapidly worse and he was walking with great difficulty. As has already been stated, he was seen by Dr. Atha Thomas, the orthopedist on service at the Children's Hospital, but it was not until November 18, 1934, that a definite diagnosis of renal rickets, based on the blood calcium and phosphorus findings, together with *x*-ray pictures of the

long bones, was made. The blood chemistry at this time was as follows: N.P.N. 108 mg.; creatinine 3.3 mg.; calcium 10.3 mg.; phosphorus 6.3 mg. The blood count was: Hemoglobin 80 per cent; R.B.C. 4,480,000; W.B.C. 11,700. Urinalysis developed a specific gravity of 1.005; albumin 1 plus; an occasional leucocyte present; occasional red blood cells; streptococci on culture. The bone changes are shown in Figures 9 and 30.

FIG. 31. B. W. (Case III). Regurgitation of cystographic media to left kidney. 1926.

FIG. 32. Cystogram of 1936, showing no regurgitation following resection in 1931.

FIG. 33. B. W. Uretero-pyelogram made in 1930.

FIG. 34. Uretero-pyelogram of same patient. 1936.

Remarks. Were it not for the bony changes in this patient, as discovered in 1934, it is questionable whether the blood chemistry alone would have given sufficient evidence to classify this case as one of renal rickets. Yet it might have been suspected although the phosphorus did not go above 6.3 mg., and the calcium showed no decrease from normal limits.

I feel confident that if the proper diagnosis of bladder neck obstruction had been made at the time of the hernia operation, and the obstruction had been relieved then, the patient would not have developed ten years later the rachitic symptoms and renal failure that slowly followed. Even in the face of the fact that his renal condition was grave in 1931, the roentgenologist did not suspect any rachitic changes. It is unfortunate that this child's symptoms were masked by the straining through of a hernia in attempts to void, and that the hernia was considered his major problem instead of the bladder neck obstruction, though the

mother was certain that the urine contained pus and was of a foul odor previous to and during this hernial hospitalization.

This patient died at his home in the summer of 1936, and I have been unable to obtain a final history.

Case III. The third patient B. W., age 16, still reports at the office, and is at the present time in excellent health. He plays basketball, is on his debating team in school, and his only defects are a slight genu valgum of the left knee and a lack of sex development. His condition is unquestionably due to a bladder neck obstruction, which was partially relieved by an open operation six years ago. The illustrations show pyelograms and cystograms, extending from 1926 to the present time. There is still evident renal pathology, but the regurgitation of the left ureter no longer exists, although the kidney outlines indicate that both are below normal in size. One may note the straight spinal column in the early pictures before the genu valgum occurred, and the one of December 1936 (Fig. 34), showing the compensating scoliosis following the genu valgum of the left knee. Roentgen pictures of the knee show no bone changes.

Before this patient came under my care, the diagnosis was that of a neurologic bladder and urethra. He still does not quite empty his bladder, and I contemplate the removal of more tissue from the bladder neck.

I feel confident that this case would have followed the other two had not his bladder neck obstruction been removed. As previously mentioned, he has one deformed leg, lack of testicular development with the other changes that go along with this hormonal deficiency, namely, no facial hair, sallow complexion, and childlike voice.

SUMMARY

1. Renal rickets is a disease of early adult life and is secondary to either unexplainable congenital defects or obstructive lower urinary tract pathology.

2. An early and correct diagnosis of the obstructive pathology with correction will prevent in many patients a fatal termination.

3. Patients who develop bone changes must show a hyperplasia of the parathyroids.

4. It is very necessary that a more accurate knowledge of renal pathology in its relation to hyperparathyroidism be sought, and vice versa.

5. Those patients who develop hypertension and edema early will never reach the rachitic stage and should be classed as interstitial nephritics.

6. In those cases of continuing low blood pressure the renal arteries show no changes.

7. There still remains no satisfactory explanation as to the lack of gonadal development.

I wish to acknowledge the splendid work done by Mr. Glenn E. Mills of the Photographic Department of the University of Colorado in preparing the plates for this paper.

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DISCUSSION

DR. CLYDE LEROY DEMING: Our conception of rickets is complicated by a mass of new ideas, for I was brought up in medicine when there was little known about avitaminosis rickets, except a bowing of the tibiae, a few humps on the wrists and ankles, the rachitic rosary, and so forth. And now we have handed to us rickets of the kidney.

My first conception of rickets of the kidney was a bowing of the ureter and some dysfunc-

tion of the kidney. Perhaps I have been rather backward in accepting the diagnosis of renal rickets. My conceptions of renal rickets have been further retarded by the lack of opportunity to see the cases. This is probably true also of my friends in the audience, because most of these cases have been viewed by the pediatricians and it is only recently that the pediatrician has felt that he could not get along without the urologist. I feel indebted to Dr. Howard for being one of the first urologists to bring this subject before our Society and our specialty. He has given us a clean-cut picture of the disease in children, which is characterized first by renal deficiency, usually by a urine with a low specific gravity and alkaline in reaction or near the neutral point, a high non-protein nitrogen, a blood chemistry picture of lowered calcium and increased phosphorus, and an *x*-ray picture which is characteristic of hyperparathyroidism.

Before some of these problems are cleared up we must know more about the *x*-ray picture in hyperparathyroidism; we must know more about osteomalacia, cystic disease of the bone, the epiphysis in syphilis and Paget's disease.

Dr. Howard has attempted for the first time to classify these cases of renal rickets. I have never attempted to classify them. I do not know who has, and I honor him in his attempt. We have only had five cases at the New Haven Hospital. In trying to classify them in the same manner as Dr. Howard, I find I can say that two belong to the congenital type without dilatation of the ureters or any evidence of obstruction. Two cases had obstruction, one at the bladder neck and the other at the lower ends of the ureters. The fifth case was a puzzle. It presented all of the usual bone pictures which have been demonstrated. The urinary picture was compatible, the non-protein nitrogen was high; but the blood chemistry was normal.

There have been a few reports of cases which showed a normal calcium and a very slight, if any, elevation of the blood phosphorus. That brought to my mind the question as to whether or not there were any phases of this disease during which there was an attempt at recovery and a "speed-up" of certain processes. In reviewing this fifth case of ours, we found that the skull plate, instead of being woolly in type, or a granular skull, as our radiologist wished to explain this film, there were certain areas which looked as though there had been an attempt to deposit calcium. Some of these patients at times have a return to almost normal blood calcium and very little elevation of blood phosphorus. Dr. Howard has shown that one of his cases demonstrated this change. These changes in the blood picture and in the *x*-ray may signify regressions in the disease. Whether this conception is true or not, it is a problem for us to consider.

With regard to the definite etiology of renal rickets, there are several reports by Parsons, Pappenheimer and Wilens, who have shown that a long-standing nephritis may be the underlying factor. A low blood calcium and a high phosphorus usually develop in a case with interstitial nephritis of long standing, or in a case with congenital nephritis. Dr. Howard, as well as other writers, has stated that in an interstitial nephritis case the phosphorus may not be put out through the urine, but goes into the intestine and unites with the calcium, making an unabsorbable compound, with the result that there is a depletion of calcium. Where there is a long depletion of calcium, there is probably a stimulation of the parathyroid producing a hyperplasia of the parathyroid as a compensatory reaction. We then get those changes in calcium metabolism which are shown in the *x*-ray films.

Let us look at the opposite side of the calcium metabolism picture. Take, if you will, a hyperparathyroid case and allow it to exist over a long period of time. The patient will develop a nephritis. Both diseases produce changes in the calcium metabolism with practically the same *x*-ray bone pictures, but the blood chemistry for calcium and phosphorus is reversed.

Why do we have in this disease a complication of hypogonadism? I am particularly interested in hypogonadism. I believe that the thymus, the thyroid, and the pituitary play a big part in it. That brings in the question whether or not this picture of renal rickets is not still more complicated than we appreciate. A low blood pressure depends much on the thyroid and the adrenal. May we not, just for the sake of arguing, inject possibly the thyroid and adrenal into this picture? The fatty infiltration of the adrenal which has been shown us may be positive evidence of multi-hormonal involvement.

But I am not content to explain this picture wholly on the basis of renal insufficiency of congenital origin or on a hormonal basis. The acquired type which has been discussed seems acquired only to a certain degree. Why should

we blame an obstruction of the urinary tract for renal rickets when we see renal rickets without urinary obstruction? Why do not our prostatic cases, which have an obstruction over a long period of time, develop similar changes in the blood picture and in the gonads? If we rely on the kidney alone, why do not polycystic kidney cases develop more changes in the blood pictures? These have a long-standing nephritis.

I believe that we must take one step further back. We have seen injured cord cases develop a hydro-ureter and a hydronephrosis without obstruction. Here there is an injury to the sympathetic and parasympathetic nerves. Harvey Cushing has stated in his book on the pituitary that lesions of the pars intermedia and pars posterior produce a hydro-ureter and hydronephrosis without any evidence of obstruction in the urinary tract. These are associated with hypogonadism, low blood pressure, and so forth. I would like to suggest that perhaps these cases of renal rickets are not due simply to a congenital malformation of the kidney, but to a congenital malformation of the diencephalon.

The prognosis in these cases is bad, according to all the literature of the pediatricians. I commend Dr. Howard for bringing before us tonight the fact that he has brought a case of so-called renal rickets through a period of obstruction up to the age of 16. This patient is in better health than any of the cases I have seen or read about.

DR. EDWIN BEER: The only adequate excuse I can offer for entering the discussion of this interesting group of cases is to be found in the fact that the first paper I wrote was devoted to a closely related subject—metastatic lime deposits—as well as to the fact that some twenty-two years ago I published a study of a series of cases similar to the acquired group referred to by Dr. Howard, and have seen well over fifty such cases, many of which are described in our monograph on "Diseases of the Urinary Tract in Children."

After reading carefully the paper of the evening, I cannot convince myself that Case I was anything else than a case of infantile rickets, and that following the attack of scarlet fever at five years the patient developed an interstitial and fatal nephritis. MacCallum, thirty-two years ago, called attention to the association of renal diseases and parathyroid enlargement which seems to have been present in this case, though in the autopsy notes no mention of the microscopic picture, whether hyperplasia or adenomata, was made. The inability of the badly diseased kidneys to excrete allows of accumulation of phosphoric acid ions, which may act on the calcium in the bone and as compensation for this upset in the calcium metabolism, possibly the parathyroids become enlarged and hyperplastic. In Case I the disease of the bones seems to have begun before the child was 2 years old, so that I cannot agree with Dr. Howard's conclusion that this was a disease of early adult life.

In Cases II and III, the disease also started in early life, in one surely at 2 years. These cases correspond with the cases that I have been studying for almost thirty years. They seem to be cases of dysharmony between the detrusor and sphincter muscles of the bladder, and regularly develop fibrosis with contracture of the bladder neck. The pathology at the neck leads to back pressure effects, hypertrophy of the bladder—giving way of the ureter meati and usually bilateral dilatation of the ureters and kidney pelves with atrophy of the parenchyma. When infection develops, they usually come to the urologist. In the large series of cases that I have studied, most of the children are undersized, poorly nourished and pale. They might be classified in some instances as infantile or dwarfed, but as far as I can recall, none showed evidence of rickets. In those cases of contracture of the neck, associated with bone changes, perhaps the parathyroids and poor renal function are again producing the picture.

Alfred Hess says; "It is possible that the effect on the metaphysis is due largely to the fact that the nephritis occurs at a time when the bones are in the stage of active growth." It is of great interest to note that Ellis and Evans collected in the London Hospital twenty cases in as many years belonging to the group associated with contractures of the neck, though they seem to have failed to recognize this pathology. Under "Renal Dwarfism," they describe the same clinical picture of obstruction at the bladder neck, and in fourteen out of seventeen autopsies in this series they found "varying degrees of dilatation, which in some cases was extreme." Moreover, they state that "the urinary retention appeared to occur at the level of the urethrovesical sphincter. No obvious cause of the obstruction or lesion of the nervous system was found. A disorder of the neuromuscular mechanism control-

ling the urethrovesical sphincter is suggested." Unfortunately the case histories and the autopsy reports are so briefly given that they are of little value in elucidating our problems, and still more unfortunate, the post-mortem examinations seemed to have regularly avoided the parathyroids, which surely are an important factor in the secondary bone changes, as has been again emphasized by Shelling and Remsen in a recent publication of a base belonging in this same group of contractures of the bladder. In this case all four parathyroids were hyperplastic and very large.

From these few words it can be readily seen that we are still rather in the dark concerning what is called renal rickets, and we all are indebted to Dr. Howard for reminding us of this still obscure clinical picture, so that as opportunities offer, we can delve a little deeper into this borderline group of patients and help in their elucidation.

DR. MEREDITH F. CAMPBELL: Concerning so-called renal rickets, so irregular are the pathologic and clinical manifestations, as well as the laboratory findings, notably the blood calcium and plasma phosphorus estimations, that terminology alone is a matter of no small moment. Park and Elliot in Brennemann's recent "Pediatrics" discuss at considerable length why the designation renal rickets, renal infantilism, renal dwarfism, and so forth should be replaced by that of renal hyperparathyroidism with osteoporosis (osteitis) fibrosa cystica.

The problem of so-called renal rickets interests me greatly because we have here a serious condition which conceivably may be prevented by early recognition of the usual basic etiologic factors, viz., obstruction. The condition is but another which illustrates and emphasizes the importance of a thorough urologic examination in children when proper indication exists. Chronic pyuria is often present and in the cases which are not diagnosed as, and interminably treated for "chronic pyelitis," the diagnosis of chronic interstitial nephritis is made. The clinical and laboratory picture of chronic interstitial nephritis is so often produced by advanced urinary obstruction affecting the total renal secretory apparatus that it is my feeling, and I am sure it is Dr. Lyttle's also, that patients in whom this diagnosis is made should at least be subjected to an excretory urographic study. When the renal function is low and intravenous urography is therefore of no aid, the urethral and/or ureteral catheter may advisedly be employed, in many cases together with cystography and retrograde pyelography. In a few children in this group in whom Dr. Lyttle and I were mutually interested, only a thorough urologic examination disclosed the obstruction and urostatic nature of the basic pathology of the "chronic interstitial nephritis."

Moreover, it is likely that urologists fail to recognize many of these cases of renal rickets; I think I have correctly observed five cases, but am sure many more went unrecognized. Three of these cases were seen with Dr. Lyttle and doubtless he will discuss them; they came to autopsy. In a 7 year old boy with renal rickets, congenital bilateral renal hypoplasia existed. Post-mortem, diminutive kidneys were found with a ureter coming from the anterior surface of each organ. In another boy of 4½ years, but 2 years in size, advanced bilateral hydronephrosis resulted from bilateral ureterovesical junction stricture; there is secondary ureteropelvic angulation obstruction. This boy appeared and acted like a little old man; he was bow-legged, wizened, looked worried, and there was beginning baldness of the anterior third of the scalp. The non-protein nitrogen was 65 mg. per 100 c.c. of blood. Bilateral nephrostomy was performed and the boy was returned to his home. Marked general as well as renal improvement has occurred and we hope eventually to relieve the obstruction on each side.

What appears to be a genuine case of renal rickets was studied at Bellevue Hospital in June, 1936. A 7-year old boy weighing only 26½ pounds was admitted with a diagnosis of congenital nephritis. He had been treated at other hospital dispensaries in the past. He had never been well, never gained, was constipated, cachectic, and had a brown tint to his skin. This curious skin pigmentation has been noted in several of the reported cases of renal rickets. The breath was offensive; the lower ribs flared with some beading; the mentality was below average, and a serosanguinous anal discharge existed. The blood pressure ranged between 136/98 and 164/112 mm. Hg. There was a mild leucopenia; the red cell count varied between 1,200,000 and 1,700,000, with 49 per cent hemoglobin despite three transfusions. The phenolsulfonphthalein test showed no dye was excreted. The non-protein nitrogen was 197 mg., 208 mg. and creatinine

7.3 mg. per 100 c.c. of blood. The urine showed albumin 2 plus, occasional white and red blood cells. Notably, the serum calcium (diminished) was 5.4 mg. and the plasma phosphorus was 13 mg. (increased). The CO_2 estimation was 26.7 volumes per cent. Intravenous urogram showed no excretion. The cystogram was normal (no reflux or residuum). *X*-ray of the long bones showed no rachitic changes; the upper end of the right humerus showed changes of osteochondritis juvenalis deformans. The treatment employed was three transfusions; saline and 5 per cent glucose; high caloric diet; 5 c.c. of 10 per cent calcium gluconate was given intravenously daily for four days. The patient died of renal failure three weeks after admission. No autopsy was obtained; we had withheld retrograde pyelography under the erroneous impression autopsy permission was obtainable. This boy, we believe, had true renal hyperparathyroidism; certainly the low blood calcium and high plasma phosphorus suggest this.

DR. JOHN D. LYTTLE: I think everybody agrees that renal rickets, renal dwarfism, and renal infantilism, are not good terms for this disease. Rickets is not an obligatory part of the picture; its presence depends entirely on the bone age. If growth is complete, bone changes may occur without dwarfism being present, so that is not necessary; and infantilism has been present in only a few of the cases on record. The term used by Park and Elliot, and advocated by Allbright and his co-workers, describes the pathology and the clinical picture. It is renal hyperparathyroidism with osteoporosis (osteitis) fibrosa cystica.

A study of the pathology gives the key to pathogenesis; the primary condition is renal insufficiency, which can be brought about in more than one way. In some of the cases reported there is a definite renal hypoplasia. In the first case we studied at the Babies' Hospital, the kidneys of an 11-year old boy weighed 20 Gm., the normal weight for a newborn infant. In addition, the kidneys showed cystic degeneration and fibrosis.

Urinary tract obstruction and infection, if they persist long enough, lead to renal insufficiency. The obstruction can be due to a neurogenic bladder, or any one of the urological conditions which give rise to vesical outlet obstruction. Infection usually develops, which leads to destruction of the kidney and to fibrosis or nephrosclerosis. Edema, retinitis and hypertension are not commonly found in these children.

The second thing to consider in the pathology is the parathyroid glands. I should like to ask Dr. Howard about the histopathology of the enlarged parathyroid glands in the case he showed. I take it the enlargement was simple hyperplasia, and not an adenoma, as is common in primary hyperparathyroidism.

The third pathologic change of course is in the bones. In a very young child, where endochondral growth is going on, rickets of variable severity will be found. In an older child there will probably be moderate changes in the endochondrium and knock-knees or bow-legs are present, and in a still older patient, where endochondral growth is complete, little or no deformity is seen. Anatomically, the changes are at times rickets, but the essential finding is osteoporosis such as we see in hyperparathyroidism. That hyperparathyroidism is a direct result of renal insufficiency seems likely. I believe that experimental work and clinical investigation will prove that definitely. Dr. Pappenheimer and Dr. Wilens and others have found that in patients dying of chronic Bright's disease there is from 100 to 200 per cent increase in parathyroid weight as compared to a control series. These workers have reduced the kidney tissue in animals, and have demonstrated hyperparathyroid glands at autopsy. Work recently published by Hamilton and Highman indicates that in individuals who have advanced renal disease, hyperparathyroidism is present, as shown by the Hamilton and Schwartz test. It is not known how this renal insufficiency induces hyperparathyroidism, or what produces the demineralization which goes on in this disease. Park believes that in renal insufficiency phosphate retention results in low serum calcium. This altered calcium-phosphorus equilibrium the parathyroid glands attempt to overcome and they become hypertrophied. The bone changes are a result of the overactivity of the parathyroid glands. Identical changes in the bones are seen in primary hyperparathyroidism and following experimental injection of parathyroid extract in animals. But the mechanism by which these bone changes are brought about is still uncertain.

Before discussing treatment I should like to ask Dr. Howard about the changes in kidney function as clinical improvement occurred in his third case.

We will all agree that the pediatrician and the practitioner see these children before bone changes occur, when treatment can be effective. It is of little benefit to the patient to establish drainage, remove obstruction and fight infection when kidney insufficiency is well established and bone changes are present. In patients with chronic urinary tract infection we must not be misled by good kidney function and by apparent well-being, but must constantly bear in mind that changes in the kidney are slowly but surely progressing and will eventually lead to renal failure. It is up to us to present these cases to the urologist at a time when treatment can be effective.

DR. T. LEON HOWARD (*closing the discussion*): Dr. Deming mentioned the resemblance of the bone changes in renal rickets to those in Paget's disease, and there must be a similarity, for I asked one of our pathologists to give his opinion of the slide from which the photomicrograph (Fig. 6) was made, and without hesitation he said it was the bone from a case of Paget's disease. He frankly admitted he had never seen the bones of a renal rachitic.

The thymus showed no pathology and in none of the case reports I have seen, has the thymus been described as a possible factor.

I still insist it is a disease of paradoxes and offers the widest field for research, especially from a hormonal standpoint, to say nothing of the renal and parathyroid relationship.

The copy of this paper sent to Dr. Beer unfortunately omitted the pathologist's microscopic report on the parathyroids, but I assure him there was no adenomatous change in any of the glands and their enlargement is due to hyperplasia, as shown in Figure 13. I mentioned the fact that there was a difference in the blood as well as in the bones in patients having adenomas of the parathyroids, for in this condition the exciting lesion is in the parathyroid, while in the renal rachitic the parathyroid change is secondary, and is a physiologic result of the renal and blood pathology.

The urologist will be of little benefit in the type of patient I reported in detail, for the bone changes begin early in life, due to some unknown prenatal renal defect. But in the other two cases, if the physician will allow the urologist to see this obstructive type early enough, I feel sure he will be able to prevent, in a certain percentage, the bone changes which are unquestionably secondary to the renal pathology.

Dr. Beer is, of course, correct in that all cases of lower renal obstructive lesions do not go on to the rachitic state, and I didn't intend to leave such an impression.

In closing, I want to thank the members of the Academy for being allowed to present the subject of renal rickets for their consideration and to the discussers for their most generous and frank opinions.

DIFFICULTIES IN URETHRAL CATHETERIZATION

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ONE usually thinks of urethral catheterization of the male patient as too simple a procedure to warrant much consideration. Yet there is hardly a physician in practice today who has not at some time been in the very embarrassing position of being unable to pass a urethral catheter to relieve a distressed patient who has had a full bladder. At The Mayo Clinic we daily have inquiries from visiting physicians as to our equipment and manner of procedure in handling patients who are difficult to catheterize. Nearly every young physician taking graduate work in a medical center, no matter what his specialty, calls on the urologic department for suggestions as to the types of catheters he should purchase before going into private practice, and for instruction in their use.

The results of unsuccessful or poorly done urethral catheterization are too commonly encountered, and they are especially serious in cases in which the patients are elderly debilitated men who are suffering from urinary obstruction as a result of prostatic enlargement or stricture of long standing. False passage of catheters, injuries to the prostate gland, urethral hemorrhages, periurethral abscesses, severe urinary infections, and unnecessary suprapubic operations and cystostomies bear witness to the difficulties that are encountered in this so-called simple procedure. The physician who does not specialize in urology often becomes so confused at the innumerable urethral instruments described in the urologic literature that he is at a loss to know just which ones to acquire and the proper indications for the use of each. For the average practicing physician to be adequately equipped for such work does not require the large number of instruments found in the office of the urologist, but rather a carefully selected list of instruments and a thorough knowledge of when and how to use them. This brief outline is merely an attempt to suggest to the general practitioner a suitable minimal armamentarium, and to review a few practical anatomic points and technique that may be of value when he is confronted with a case in which catheterization proves difficult.

ANATOMIC CONSIDERATIONS

It will be recalled that there are two portions of the anterior urethra in which the diameter of the urethral lumen is enlarged, namely, the fossa navicularis and the bulbous urethra. As the roof of the urethra is fixed and relatively inelastic, these variations in diameter of the urethral lumen are formed at the expense of the freely movable and elastic urethral floor. The posterior urethra is relatively fixed because the membranous portion traverses the triangular ligament while the remainder traverses the prostate gland. If the penile urethra is held at right angles to the body it forms an almost straight tube to the juncture of the bulbous and membranous portions of the urethra, from which point there is a definite fixed curve into the bladder. Normally, the anterior portion of the urethra is easily catheterized as the floor molds itself readily to the shape of the catheter. However, because of this laxity of the floor of the anterior urethra, it is also easy for one to catch the tip of a urethral instrument in a fold or pocket of mucosa and exaggerate it. (Fig. 1.) This will prevent passage of the instrument or break the mucosa of the floor and produce a false passage. For this reason, in the

passage of instruments it is always imperative to have the instrument hug the roof of the urethra.

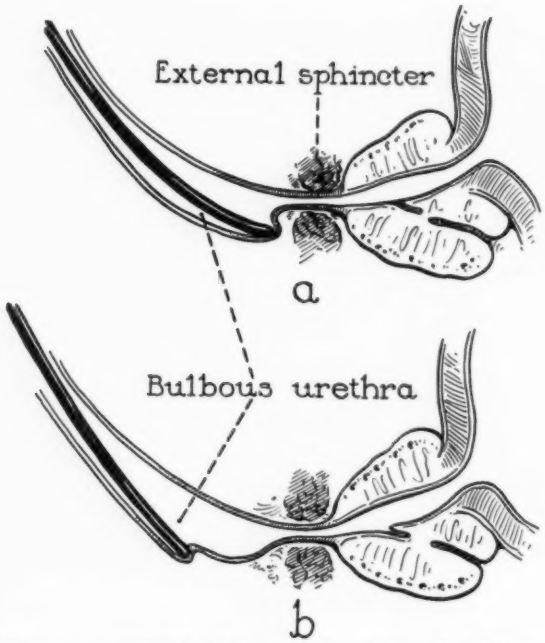

FIG. 1. A, sagittal section of normal urethra illustrating instrument caught in the floor of the bulbous urethra at its junction with the membranous urethra. B, instrument is caught in a fold of mucous membrane further out in the anterior urethra.

Probably the most common troublesome point encountered in urethral instrumentation is in the bulbous urethra. The reason for this is apparent. The lumen of the bulbous urethra is large and may sag considerably below the level of the posterior urethra. Because the posterior urethra is fixed and its entrance is guarded by the external sphincter (which normally is in a state of contraction), it furnishes a definite moderate obstruction to the passage of any instrument. The tip of the instrument has a tendency to drop into the floor of the bulb, push against the wall of the bulb and form a pocket, instead of making the upward curve and dilating the sphincter. (Fig. 1.) If too much force is applied it will result in a false passage. Spasm of the sphincter, of course, exaggerates this difficulty.

The next most common point of trouble in the normal urethra is at the internal sphincter or neck of the bladder. It is not uncommon for this sphincter to be irritable and by its contraction form a ledge of the posterior lip of the neck of the bladder, which will catch the tip of the instrument.

In cases of prostatic hyperplasia, several other points of difficulty arise. As the urethra traverses the prostate gland near its anterior surface, most of the adenomatous tissue is found in the floor and low part of the lateral walls. When adenomatous enlargement ensues, the floor of the urethra often becomes distorted and a "pocketed urethra" commonly results. In this type of deformity the urethral floor is pulled below the level of the base of the bladder and forms a deep pocket. If there is an enlargement of the median lobe, the condition is exaggerated. Large lateral lobes which have considerable tissue in the anterior quadrant may force the instrument into the pocket despite the attempt of the operator to see that it hugs the roof.

Carcinoma of the prostate gland tends to produce an extreme narrowing of the lumen of the prostatic urethra and render it extremely fixed and inelastic. If the carcinoma is advanced, it extends down into the membranous urethra. In this type of case it is most difficult to pass urethral instruments; at times, it is almost impossible to guide an instrument into the posterior urethra.

These anatomic and pathologic factors explain why nearly all false passages occur in the urethral floor. The overwhelming number of false passages are found in the bulbous urethra, but in cases of prostatic hyperplasia it is not uncommon to see median lobes and low-lying lateral lobes that have been completely tunneled through by the instrument used for catheterization.

INSTRUMENTS AND TECHNIQUE

The first principle of urethral catheterization is cleanliness. There is probably no other surface in the body that so readily permits bacteria to enter the blood stream

as does the traumatized male urethra. The penis, perineum, and lower part of the abdominal wall should be well scrubbed

is holding the forceps is passing the catheter, the penis should be held on tension at right angles to the body with the

Fig. 2. Method of instrumental catheterization; the hands will not touch any part of the catheter that will come in contact with the urethral mucosa.

with soap and water and, if possible, the patient should be covered with a sterile male drape. The hands of the surgeon should be scrupulously clean and the technique should be as nearly sterile as possible. One should form the habit of handling the catheter with an instrument, as in the majority of cases the patient may be catheterized without the hands touching the catheter. The technique of this procedure is illustrated in Figure 2. If the procedure becomes difficult, the catheter must be manipulated by the hands, so this should be anticipated. Antiseptics are of questionable value but may be used if desired. Care should be taken to lubricate the catheter well.

The first attempt should be made with a number 14 or 16 French, inexpensive, soft rubber catheter which has a round, solid tip. (Fig. 3A.) While the right hand, which

left hand. This makes the urethra a fairly straight tube to the juncture of the bulbous and the membranous portions and irons out mucosal folds and pockets in the urethral floor. One of the most important points to be remembered here is to pass the catheter slowly and gently in order that the patient will remain relaxed. When the catheter reaches the bulbomembranous urethra it will encounter the obstruction of the external urethral sphincter. Lack of gentleness at this point is the most common cause of failure. Gentle firm steady pressure on the catheter will gradually relax the sphincter and allow the catheter to enter the posterior urethra. A jerky, poking thrust will cause the sphincter to contract, and this will defeat the attempt to pass the catheter further. If obstruction is encountered from the internal sphincter at the neck of

the bladder, the same rules of procedure must be followed to overcome it. Too much haste often makes a normal urethra

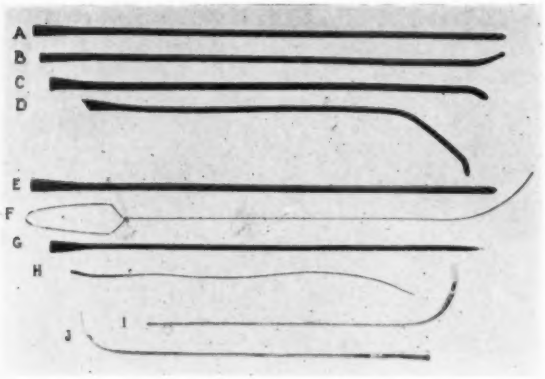

FIG. 3. Suggested assortment of catheters for the general physician: A, soft rubber catheter with round solid tip. B, soft rubber, hollow coude catheter with olive tip. C, woven urethral catheter with coude tip. D, woven urethral catheter with bicoude tip. E, soft rubber hollow catheter with round tip (Wishard). F, wire stylet with Van Buren curve. G, woven catheter with filiform guide attachment (Phillips catheter). H, filiform guide. I, metal catheter with Van Buren curve. J, metal catheter with Van Buren curve and filiform guide attachment.

an obstructive one as far as catheterization is concerned.

If, with the proper technique, the catheter cannot be passed, the most probable explanation is that the tip has caught in the floor of the bulb and is pushing the wall of the urethra ahead. (Fig. 1A.) If prostatic hyperplasia is present, the difficulty may be due to the tip of the catheter being caught in a pocket in the prostatic urethra; in this case, the catheter is unable to bend upward over the vesical neck. In either case the next catheter to try is a number 16 or 18 French, coude soft rubber catheter which has a hollow olive tip. (Fig. 3B.) This catheter has a mark on its distal end that denotes the direction in which the tip is pointing; therefore, the operator should endeavor to keep the tip pointed toward the roof of the urethra when the obstruction is reached. Gentle manipulation and firm steady pressure should cause the catheter to rise out of most ordinary pockets and find its way into the bladder. This probably is the most useful of all urethral catheters.

If these two maneuvers fail, the third attempt should be made with a woven urethral catheter of either the coude or bicoude type. (Fig. 3C and D.) The catheters are shaped to fit the curve of the urethra, which enables them to rise out of pockets; they also possess a certain degree of rigidity which allows a little more pressure to be applied without causing buckling. The operator must always remember, however, that these catheters, though not rigid, still possess the ability to break the urethral mucosa and produce false passages if too much force is applied. These catheters should be gently manipulated, but should not be forced.

If the catheterization is still unsuccessful, the operator should remember this one important point: *do not persist too long.* If too many attempts are made the patient will become exceedingly irritable, which will make the procedure increasingly more difficult. It is much wiser to stop, give the patient a hypodermic injection of morphine sulphate, ¼ gr. (0.016 Gm.), wait for thirty to forty-five minutes until it has taken full effect, and then proceed. This is probably the most important single point to remember in cases in which urethral instrumentation is difficult. If the patient can be made to relax, half the battle is won. In fully 85 per cent of such cases it will be a relatively simple procedure to pass a soft rubber or woven coude tip catheter after the morphine has taken effect. Often, a sitz bath in addition to the morphine is of value.

If, however, one is still unsuccessful, one of two procedures may be employed, depending on the preference of the operator: (1) a soft rubber catheter which has a hollow tip (Fig. 3E) may be threaded over a wire stylet (Fig. 3F); or (2) a woven catheter may be preceded by a filiform guide. (Fig. 3G and H.) The soft rubber catheter which has a hollow rounded tip and only one eye is called a Wishard catheter. A similar catheter which has two

eyes is called a Robinson catheter. Either type is satisfactory. A curved wire stylet which has a Van Buren curve should be thoroughly lubricated and a number 18 French catheter which has a hollow tip should be threaded over it. Care must be taken to be sure that the point of the stylet is well down into the tip of the catheter and that the catheter is stretched taut so the tip of the stylet will not slip back out through the eye of the catheter and injure the urethra. It is well to use at least a size 18 French catheter; if a smaller one is employed, difficulty will be encountered in attempting to remove the stylet after the catheter has been introduced into the bladder. The operator also must realize that he is now employing a rigid instrument and that gentleness in manipulation rather than force is extremely important. With this type of equipment one is able to make the point of the catheter hug the urethra and is able to guide the tip of the catheter out of pockets and false passages. Counter pressure with the free hand on the perineum or with a finger in the rectum is often a great aid in guiding the tip of the catheter into the bladder. Again, as in all types of catheterization, one should not forget to apply tension to the penis at right angles to the body, to assist in obliterating pockets and folds in the urethral floor.

Fig. 4. Sagittal section of urethra showing a filiform guide buckling at the juncture of the bulbous urethra and posterior urethra. (From Bumpus, Crenshaw and Clark, "Minor Surgery of the Urinary Tract," Saunders, 1932.)

The other method of approach (insertion of a filiform guide followed by a woven catheter) is nearly always successful, produces a minimum of trauma, and is no doubt a safer procedure in inexperienced hands. If a stricture is present, this method is by all odds the procedure of choice.[1] The woven catheter (usually called a Phillips catheter) may be secured in sizes 8 to 30 French, and a few of the small sizes are most important. In addition to being an excellent catheter, it serves admirably for gradual dilatation of urethral strictures. The most difficult part of the technique is the passage of the filiform. It should be well lubricated, the tip should be bent into a moderate curve, and the filiform should be passed slowly by rotating it back and forth between the thumb and first finger to change the direction of the tip constantly, thereby avoiding pockets and old false passages. Sometimes, in a badly pocketed or injured urethra, it is necessary to pass several filiforms to fill up the pockets and false passages before one finally can be passed into the bladder. After the filiform has entered the bladder it is usually a simple procedure to screw on the catheter and make it follow the filiform into the urethra. This may be left in for drainage for twenty-four to forty-eight hours, following which it is usually possible to remove it and pass a soft rubber

catheter. It must not be forgotten that filiforms may buckle and break if too much force is applied. (Fig. 4.) Filiform guides crack and break with age and use, so it is very important to examine them carefully for defects each time they are used.

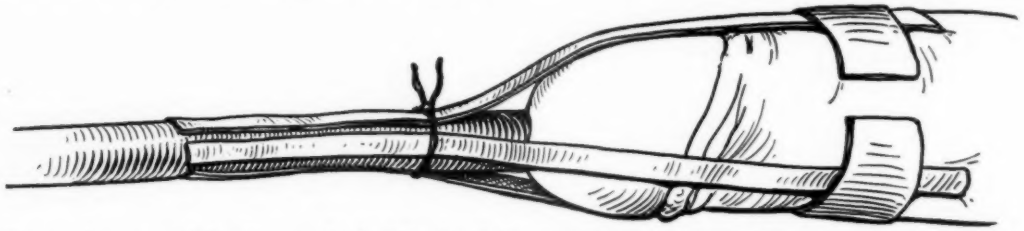

FIG. 5. A very satisfactory method of "tying in" a retention catheter; the catheter may be easily readjusted by simply cutting the ligature and peeling back the strips of adhesive tape from the catheter; after the catheter has been adjusted, the same adhesive strips may be reapplied and tied.

When all these measures fail, the condition is truly a difficult one. If the physician is expert in urethral manipulation he may choose to try a metal catheter, either with or without a filiform guide (Fig. 3—1 and J). However, much damage may be done with this instrument and in unskilled hands it is unsafe. The safer procedure, if the patient's general condition permits, is to administer a general anesthetic, preferably gas anesthesia; this added relaxation most frequently permits catheterization to be accomplished. However, if catheterization is still impossible, suprapubic drainage may be done while the patient is still anesthetized, and it is always well to remember that suprapubic drainage well

FIG. 6. A suitable type of closed bottle with tubing to connect with a retention catheter; the bottle is equipped with a hook to be hung at the side of the bed.

done is much safer for the patient than is the forceful passage of any urethral instrument.

CARE OF RETENTION CATHETERS

After catheterization has been accomplished, the physician may wish to leave the catheter in situ for several days. If the catheter is properly adjusted and tied in place, the patient will be perfectly comfortable. If the catheter is poorly adjusted it will give no end of trouble. A catheter that is inserted too deeply into the bladder may be just as uncomfortable as one that reaches only into the prostatic urethra.

A catheter to be properly adjusted should be inserted deeply, and then should be slowly withdrawn. When the catheter has been withdrawn as far as possible without interfering with the free drainage of the urine, the proper point of adjustment has probably been reached. However, after all of the urine has been withdrawn the catheter should be irrigated with a glass syringe which has a plunger. An ounce or two of fluid, when injected, should easily run back through the catheter if it is perfectly placed. It may be impossible to secure proper adjustment at first trial so the catheter should be fastened in such a manner that its position can be changed easily. There are many ways of fastening an indwelling catheter in place, but at the clinic we have found the method illustrated in Figure 5 very satisfactory. The foreskin of the penis should be well pulled down so that it will not stretch and allow the catheter to slip. Three strips of adhesive tape should be attached longitudinally, equidistant from each other, beginning well back at the base of the penis and extending down on to the catheter. The strips should be secured to the penis by a circular strip of adhesive tape. Instead of placing a circular strip of adhesive tape around the longitudinal strip on the catheter, it is much better to tie the strips of adhesive tape with fishing line or some other good strong ligature as illustrated. By using this method, if one desires to change the position of the catheter it is necessary only to cut the ligature, pull the strips off the catheter, adjust the catheter, and then reapply the strips and tie them again. This may be done many times as the tie will hold the strips securely to the catheter even though most all of the adhesive property of the tape is gone.

When a catheter is left in place for several days it is important that free drainage for urethral secretion should be maintained around the catheter. The longitudinal strips of adhesive tape should be narrow enough to prevent occlusion of the urethral meatus. It is also good policy to inspect the meatus once daily and push the glans penis well back from the adhesive tape to prevent any secretion or discharge from becoming hard and hampering free urethral drainage.

The care of the indwelling catheter is of paramount importance. If the end of the catheter is left free in a urinal or some other shallow receptacle, the chances for an ascending infection are very great. The catheter should be connected by means of a glass adapter to a long sterile rubber tube that may be attached to a closed sterile bottle of some type by the side of the bed. One suitable variety of connection and bottle is illustrated in Figure 6. Each time the bottle is emptied it should be boiled before it is replaced. It is only by adherence to this type of technique that severe urinary infections may be reduced to a minimum in cases in which continuous catheter drainage is employed.

SUMMARY

Urethral catheterization of the male patient may at times become a very difficult procedure, and if not skillfully done, it may result in serious consequences to the patient. The anatomy of the urethra should be carefully borne in mind, as false passages are most commonly made in the floor of the bulbous urethra, due to the laxity of the floor of the bulbous urethra and its position in relation to the external sphincter and the fixed prostatic urethra.

It is always well to attempt to hug the roof of the urethra with the urethral instrument. Relaxation of the patient is most important and is best secured by gentleness of manipulation. If necessary, morphine should be employed. A well-selected group of the various types of catheters and a knowledge of when and how to use them will nearly always solve the problem of difficult catheterization. When a catheter is to be left in place for any length of time it should be properly adjusted and fastened in such a way that its position may be readily changed if it slips out of adjustment. A sterile connection to a sterile closed receptacle will reduce ascending urinary infection to a minimum.

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Gonococcal infection of the testis and epididymis responds rapidly to diathermy. Pain is quickly abolished. . . . Tenderness and swelling subside. . . . Inflammatory thickening of the skin of the scrotum disappears. From—"Diathermy" by Elkin P. Cumberbatch (William Wood).

TRAUMATIC LESIONS OF THE KIDNEY

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ALTHOUGH injury of the kidney is relatively common, divergent opinions persist regarding the proper management of these cases and the late results that may be expected following various types of immediate treatment. The present study is based on forty-five cases in which the diagnosis of ruptured kidney was made at the Mayo Clinic from 1910 to 1933, inclusive. We considered only those cases in which the kidney had been ruptured by external violence without penetration of the skin.

Twenty-four of the patients were seen immediately or within one week following injury, eleven were first seen from one week to one month following the initial injury, and the remaining ten patients were first seen from one month to several years or more following injury. Thirty-one of the forty-five patients have been followed to the present time. The literature is not reviewed in detail, but for those who are interested a small bibliography is appended.

INCIDENCE

The incidence of ruptured kidney as compared with other traumatic lesions is relatively low. Most renal injuries occur during the period of life when physical activity is greatest. In the present series of cases, the youngest patient was 3 years of age, the oldest 65, and the average age was 26.4 years. Injury occurred as often on one side as the other, and there was no case of bilateral injury. There were approximately six times as many males as females in this series. The fact that men commonly engage in activities which predispose to trauma, and the fact that the lumbar region in women is protected by a wide iliac crest and a thick layer of adipose tissue, may explain the higher incidence of renal injuries in men. Children have a small amount of perirenal fat and a more elastic and less well developed thorax than adults, and consequently injury to the kidney may occur more readily. A markedly diseased kidney may be ruptured more easily than a normal one. In the present series of cases in so far as we could determine, only three kidneys were abnormal at the time of injury. One of these revealed hydronephrosis and contained stones; another was invaded by a tumor of the suprarenal gland, and the third, which was removed nine months after injury, revealed a small amount of tuberculosis, which was apparently an incidental finding.

ETIOLOGY

Various types of trauma may result in rupture of the kidney. In the present series of cases falls, automobile accidents, and kicks in the lumbar region were the three most frequent forms of trauma, falls alone constituting approximately 40 per cent of all injuries. In general, any force of sufficient magnitude applied to the renal region, whether it be a severe blow or a compressing type of trauma, may result in rupture of the kidney. Severe muscular contraction or a forceful fall on the feet or buttocks may cause sufficient violence to the kidney to result in rupture. There were three cases in which muscular pull alone was responsible for the injury, and this occurred while the patient was lifting a heavy object.

PATHOLOGY

The type of renal injury that occurs is variable and is not necessarily dependent on the nature or severity of the trauma. (Fig. 1.) Küster[19,20] emphasized the importance of hydrostatic pressure within the kidney acting against compression from

without, and thought that physical laws of pressure rather than anatomic relationships were responsible for the lesions that usually being composed of blood and urine in varying amounts.

If injury has not been too severe, healing

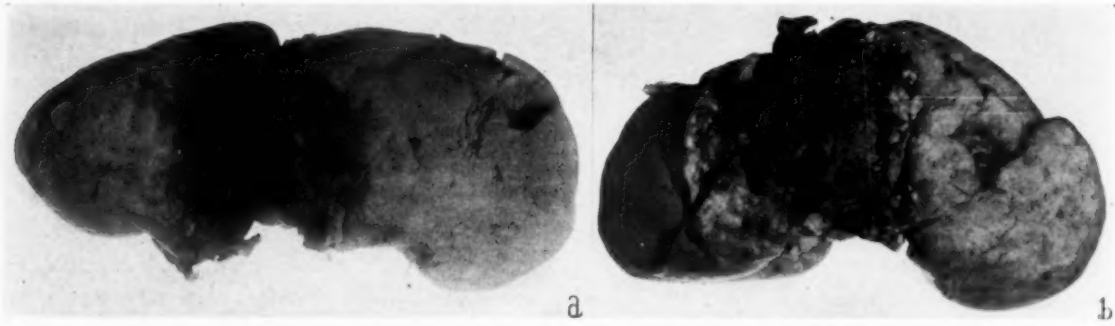

FIG. 1. Two ruptured kidneys for which nephrectomy was performed in each instance.

occur. The injury may vary from only a slight extravasation of blood beneath the capsule to complete pulpefaction of the kidney. Occasionally the upper or lower pole may be torn loose, but most commonly one or more deep tears occur in the parenchyma and hematuria results. The renal pedicle may be avulsed or the ureter may be completely severed, in which case hematuria is usually absent.

Hemorrhage may be slight or profuse, depending on the extent of the injury. There is often extravasation of considerable blood into the perirenal tissues, forming a palpable tumor in this region. If hemorrhage remains confined within the fascia of Gerota, the increased pressure that gradually results will usually stop bleeding before exsanguination occurs. In contrast, if the peritoneum is lacerated, blood may escape freely into the abdominal cavity and hemorrhage may be fatal. The most severe hemorrhage occurs when the vessels of the renal pedicle are torn.

If injury is insufficient to cause complete cessation of renal function, urine continues to form, and it may escape into the perirenal tissues and increase the size of the hematoma that is already present. If there is no infection this extravasation remains sterile. However, if infection is present, or develops later, a large abscess often results. Approximately one-third of the patients in this series had a mass in the perirenal tissues following injury, the mass may take place with a satisfactory functional result, although some anatomic deformity may persist. (Fig. 2.) In other cases immediate healing will be unsatisfactory and undesirable sequelae will develop. The most frequent causes of trouble soon after the injury, other than hemorrhage, are renal and perirenal infection and a persistent urinary fistula that may develop following the evacuation and drainage of a perirenal hematoma or abscess. The two most common late conditions which cause trouble are traumatic hydronephrosis and traumatic pseudohydronephrosis. A true hydronephrosis may result from obstruction by scar tissue in the region of the upper portion of the ureter. This may develop within a few months and not cause symptoms for some years. Three such cases were observed in the present series. If the renal pelvis or ureter is torn and urine escapes into the perirenal tissues, pseudohydronephrosis may result. Such a perirenal collection of urine may be gradually absorbed or partially drained through an existing connection with the renal pelvis or ureter. In the latter instance, a communication exists between the pelvis or ureter and a cavity in the perirenal tissues in which urine may collect intermittently. This might be compared to a diverticulum of the bladder in which urine collects and becomes stagnated and is then emptied more or less completely. It is quite common for infection to appear under such circum-

stances, and pain, chills and fever often result. Pyelographic studies will usually differentiate true hydronephrosis from pseudohydronephrosis. Renal function following injury depends largely on the nature and extent of the traumatic lesion and the effect that healing has on the normal anatomic relationships of the kidney and ureter.

Fig. 2. Intravenous urogram (June 1936) showing residual anatomic deformity of left kidney but good function. The patient, a boy aged 8 years, injured his left kidney by a fall in August 1934, a perirenal hematoma being evacuated at this time. In 1936, the urine was sterile and the patient had no symptoms.

Fig. 3. Bilateral retrograde pyelogram (November 20, 1931) showing normal left kidney, and some dilatation of the pelvis and rather abbreviated calices but no extravasation of medium on the right side. The patient, a man aged 30 years, injured his right kidney, November 1, 1931, there being gross hematuria for ten days, and localized pain and tenderness in renal region for three weeks. Medical treatment was employed. The patient was free of symptoms four years later.

ASSOCIATED INJURIES

It seems superfluous to mention that every patient who has a ruptured kidney should be carefully examined for any coexisting injury. In the present series of cases there were very few such injuries found. The nature of an accident which causes rupture of the kidney is oftentimes such that there is no external evidence of violence or any injury in other parts of the body. In only three cases did cutaneous abrasions require special attention, and intra-abdominal lesions of any severity occurred in only two cases. In one case there was rupture of the spleen; in the other, rupture of the liver. Skeletal injuries were found in six cases in all and included a fractured skull, a fracture of the twelfth thoracic vertebra, fractured ribs in three cases, and a lacerated scalp and fractured fibula in another case.

DIAGNOSIS

The three cardinal features in cases of rupture of the kidney are: (1) a history of trauma; (2) hemorrhage; and (3) pain. Occasionally trauma may be very slight, as in the case reported by Voit in which a woman's kidney was ruptured by pressure from her husband's hand while they were waltzing. Hemorrhage is manifested either

as hematuria or as a perirenal hematoma or both. Gross hematuria occurred in 75 per cent of cases, and microscopic hematuria was present in 95 per cent. Gross hematuria may occur only once or twice, or it may persist for several weeks. Occasionally it disappears after a day or so and recurs a short time later. Microscopic hematuria usually persists for some few days following cessation of gross bleeding. There seems to be no definite relationship between the amount or duration of the hematuria and the extent of the renal injury or necessity for operation. As a rule, however, when gross hematuria occurs, injury is usually more extensive than when microscopic hematuria alone is present. In the only two cases in which microscopic hematuria did not occur, the ureter was completely avulsed in one case, and the renal pedicle was torn in the other. At times a blood clot in the ureter may prevent hematuria and cause pain which suggests renal colic.

FIG. 4. Right retrograde pyelogram made six months following injury shows only slight clubbing of calices. The patient, a man aged 43 years, had microscopic hematuria for five weeks. He received medical treatment and was perfectly well six years later.

FIG. 5. Right pyelogram, showing marked deformity of pelvis and calices, especially the middle and lower ones. The patient, a man aged 51 years, injured his right kidney by a fall September 17, 1930. There was gross hematuria for two weeks, and severe pain and tenderness in the right renal region for several weeks. On admission to the clinic May 26, 1931, he complained of pain in right side. Infection was present in right kidney and its function was markedly reduced. The left kidney was normal. Nephrectomy was performed June 3, 1931, and the patient was entirely well three years later.

Pain of varying degree is invariably present, and localized tenderness and rigidity in the renal region are in proportion to the severity of the injury. Depending on the nature and extent of the injury, other abnormalities may be present. A mass was found in the flank in approximately one-third of the cases, and in this group it is interesting to note that all but one of the patients were subjected to immediate operation. If infection occurs in a perirenal collection of urine and blood, chills, fever, and increased pain may appear. Sometimes the localized tenderness and rigidity in the renal area render palpation of a mass rather difficult.

Definite evidence of shock occurred in only three cases, and each of these patients

had additional injuries, namely, rupture of the spleen, rupture of the liver, and fracture of the skull. There may be complete suppression of urine during the period of shock. Other patients presented varying degrees of faintness, pallor, weakness, nausea, and vomiting, which were usually proportional to the amount of pain and severity of the trauma. Shock immediately following trauma is usually caused by the severity of the injury, whereas shock which develops later is more often caused by hemorrhage.

The abdominal findings will vary according to the amount of abdominal trauma and the presence of blood within the peritoneal cavity. Some abdominal tenderness, rigidity, or distention may be present without any actual intra-abdominal lesion, so-called traumatic peritonism. In these cases the signs and symptoms of peritoneal irritation gradually subside and disappear in contrast to those in which an actual lesion is present. The pulse rate may be elevated by shock, pain, excitement, or bleeding. Significant changes in blood pressure are not usually noted except in cases of shock or gross hemorrhage. Some fever soon after injury is common (in 50 per cent of cases) unless shock is present, and occasionally chills may also occur. The occurrence of chills usually signifies a more serious condition for which operation will probably be necessary.

Routine laboratory studies immediately following the injury usually reveal nothing very remarkable. The values for hemoglobin and erythrocyte and leucocyte counts are quite commonly within normal limits, although leucocytosis often develops within a short time. Subsequent blood counts vary, depending on the amount of bleeding, the general condition of the patient, and the amount of infection that is present. The value for urea in the blood is usually normal if the opposite kidney is in good condition at the time of injury.

Complete urologic investigation, including cystoscopy and pyelography, is often unnecessary and may even be undesirable immediately following injury, although some urologists feel that without such investigation accurate diagnosis cannot be made. Intravenous urography is of definite value and should be performed soon after the injury if the condition of the patient permits. If function of the involved kidney is greatly impaired, either temporarily or permanently, there may be complete failure of visualization, in which case cystoscopy and retrograde pyelography may be indicated. The essential points in the diagnosis, namely, history of injury, pain in the renal area, and hematuria together with the associated physical findings and general condition of the patient, often afford adequate evidence on which to base one's opinion regarding the proper treatment, although an intravenous urogram is almost always desirable. A plain roentgenogram of the urinary tract does not usually supply valuable information immediately following the accident. A roentgenogram of this type was made in the majority of our cases, and in only two did it demonstrate anything of significance. In one case there was a mass of increased density in the region of the kidney, and in the other, stones were visualized in the ruptured kidney. If cystoscopy is not performed immediately, complete urologic investigation is indicated later, especially if progress is unsatisfactory.

TREATMENT

It is difficult to be dogmatic regarding the proper treatment for recent rupture of the kidney as this depends on the extent and severity of the injury and the general condition of the patient. In our opinion conservative treatment is usually advisable unless it is definitely contraindicated, as many ruptured kidneys heal satisfactorily without surgical intervention. (Figs. 3 and 4.) Of thirty-eight patients seen immediately or soon after injury, twenty-five (65.8 per cent) were treated medically. Medical treatment consists of rest in bed, careful clinical observation, proper treat-

ment of any associated injuries, the administration of an adequate amount of fluid, morphine for pain, and general nursing attention. Occasionally, cystoscopy and ureteral catheterization may be necessary if a blood clot becomes lodged in the ureter. This occurred in several of our cases and prompt relief of obstruction and pain followed the establishment of drainage through a ureteral catheter. Hematuria, in our experience, is seldom of sufficient severity to become alarming, although bleeding into the perirenal tissues or peritoneal cavity may be very profuse and require transfusion and prompt surgical attention. In the average case which does not require operation, hematuria subsides and the general condition of the patient improves so that he may leave the hospital within approximately one or two weeks following the injury.

Thirteen (34.2 per cent) of the thirty-eight patients, seen because of the immediate effects of injury, were operated on. These thirteen patients may be divided into two classes: (1) those operated on at once or within a day or two following the accident, and (2) those subjected to operation only after a period of medical treatment, for a few weeks or longer, had failed to give satisfactory results.

The commonest cause for immediate operation was excessive bleeding, and this was usually confined to the perirenal tissues, but occasionally entered the peritoneal cavity. Under these circumstances a large perirenal hematoma is usually present which is caused by a tear in the renal vessels or by large rents in the parenchyma of the kidney. It is usually imperative to perform nephrectomy in cases of this type. At times a badly lacerated kidney can be preserved by large mattress sutures tied over a piece of muscle or fatty tissue. The use of ribbon catgut tied around the kidney, as advocated by Lowsley, may be quite helpful in saving a ruptured kidney. But regardless of whether or not the kidney is removed, the indication of most immediate importance is to control the bleeding.

Medical treatment may be followed by unsatisfactory progress in a certain number of cases. (Fig. 5.) This is usually caused by some leakage of urine into the tissues surrounding the kidney or some obstruction to free renal drainage. Occasionally a persistent perirenal hematoma will cause trouble. Most commonly a mass gradually forms in the renal region. This may be quite tender, and chills and fever may occur. Cystoscopic examination often reveals a practically functionless kidney on the affected side. Incision and drainage of the mass, as a preliminary, conservative operative procedure, liberates a large quantity of foul, and sometimes bloody, urine or pus. In six cases of this type in the present series subsequent nephrectomy was necessary in each case because of a persistent urinary sinus, a functionless infected kidney, recurrent perinephritic abscess, or an otherwise badly damaged kidney.

Occasionally incision and drainage of a perirenal collection soon after injury may be all that is necessary even though intermittent urinary leakage may occur for a while. In November 1934, we saw a boy,* aged 8 years, who had an intermittent urinary fistula from the left kidney following the incision and drainage of a perirenal mass resulting from a ruptured kidney six weeks prior to his first visit to the clinic. We did not advise immediate operation, although urography revealed that only the lower half of the left kidney remained and functioned. Soon afterward urinary leakage stopped entirely, and the patient had had no further trouble when last seen in June, 1936.

It is possible, as suggested by Judd some years ago, that an early conservative operation in certain cases might obviate the necessity for subsequent nephrectomy. The difficulty arises in determining soon after the injury in just which case such an operation might be feasible. As a rule, if operation is not performed and if the immediate convalescence following injury

* This case is not included in present series because of the short period of follow-up.

is satisfactory, no further serious trouble need be expected. It is true that this does not necessarily mean that the injured kidney is entirely normal, as such is not usually the case; it is, however, symptomless, working to some extent, and therefore of value to the patient, particularly if disease should occur subsequently in the opposite kidney. In exceptional cases, however, months or years following the accident, deformities resulting from scar tissue and other traumatic sequelae may require operation. Most commonly a practically functionless kidney which shows definite hydronephrosis and usually some pyelonephritis will be found. Nephrectomy is commonly necessary in these cases.

RESULTS

There were two deaths in this series of forty-five cases, but neither was primarily caused by the renal injury. In one case there was an associated rupture of the liver, and in the other rupture of the kidney occurred in the presence of an associated carcinoma of the suprarenal gland with metastasis. Of the remaining forty-three patients, thirty-one have been followed to the present time, a period of from four to twenty-six years. Of these thirty-one patients, eleven underwent nephrectomy, and in one case abdominal exploration and drainage of a perirenal hematoma was performed. All twelve of these patients have remained entirely free of any symptoms referable to the urinary tract. The remaining nineteen patients in this group who were followed up to the present time were treated medically; fourteen (73.7 per cent) of them are entirely well, but five (26.3 per cent) continue to have some symptoms apparently related to the previous renal injury. Three of the five complain of slight pain which is noted at times in the region of the injured kidney; one has pain that is moderately severe and some burning on urination, and the remaining one has urinary frequency and notices pain in the renal region on heavy exertion.

The late results following rupture of the kidney are obviously more uniformly satisfactory after nephrectomy than after medical treatment; however, none of those whose symptoms still persist following conservative management of the original injury is incapacitated. If symptoms are sufficiently troublesome in these cases, operation can always be performed. With the exception of one patient, the complaints are all mild and occur only infrequently.

SUMMARY

Forty-five patients who had rupture of the kidney were studied. The majority of them were young adult males. Only those cases were considered in which the kidney was ruptured by external violence without penetration of the skin. The type of renal injury varied from slight subcapsular hemorrhage to complete pulpefaction of the kidney. In some cases the ureter or renal pedicle was completely avulsed. Hemorrhage, usually perirenal, but occasionally intraperitoneal, was uniformly present, and hematuria, either gross or microscopic, occurred in 95 per cent of the cases. Leakage of urine around the kidney was common. Serious associated injuries elsewhere in the body were present in 13.3 per cent of cases. Healing may occur satisfactorily with medical treatment, or on the other hand urinary fistulas, hydronephrosis, pseudohydronephrosis, pyelonephritis, or anatomic abnormalities of varying degrees may persist or develop. A history of trauma and hemorrhage and pain are cardinal points in the diagnosis, but they should also be substantiated by intravenous urography. In general, medical treatment immediately following the injury is preferred unless contraindicated. In certain cases in which patients are treated medically, subsequent operation may become necessary.

The two deaths that occurred in this series of forty-five patients were attributed to severe extrarenal trauma. Thirty-one patients were followed for a period of from four to twenty-six years following injury.

Eleven patients who underwent nephrectomy are entirely free of symptoms; 73.7 per cent of those treated medically are entirely well, and the remainder of this group have mild symptoms referable to the urinary tract.

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MEASUREMENT OF KIDNEY FUNCTION BEFORE, DURING, AND AFTER PREGNANCY

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MANY women with nephritis have become pregnant. Some have lost their babies, while others have lost their lives or have suffered increased permanent kidney damage. Eclampsia has been called uremia or nephritis, and nephritis has been diagnosed as eclampsia. Many women with severe nephritis have been allowed to become pregnant and to carry their babies without any warning as to the condition of their kidneys, and many women who have had toxemia of the eclamptic type have been warned never to become pregnant again because of kidney disease. These mistakes constitute a strong argument in favor of an accurate estimation of the kidney function of nephritic and of toxemic patients.

In the case of a patient with nephritis, kidney function should be determined frequently—not only during her pregnancy and subsequently, but also, if possible, before she becomes pregnant. Occasionally a nephritic patient consults her physician for the treatment of sterility. Study of her renal function may reveal the kidney efficiency to be seriously impaired, so that instead of being treated for sterility she should be warned against pregnancy. In the case of the toxemic patient the kidney function should likewise be tested during and after pregnancy. Hence, with certain degrees of kidney dysfunction the physician can advise his patient against pregnancy. If the patient is already pregnant, he can foresee probable severe renal insufficiency and either interrupt the pregnancy or induce premature labor to avoid the development of this condition. It is possible, therefore, by means of kidney function tests, to determine with a fair amount of accuracy which patients can safely become pregnant and to predict which patients will suffer permanent additional damage if allowed to continue with pregnancy.

Kidney damage of any practical importance to the physician is measured by decrease of kidney function. There are numerous tests for kidney function, all based upon one of three principles: (1) the elimination of administered substances such as dyes; (2) the excretion of nitrogenous waste materials; or (3) the ability to concentrate and dilute urine.

The primary physiologic function of the kidneys is to excrete water in the form of urine. It follows, therefore, that tests which measure the ability of the kidneys to excrete water and concentrate urine measure the kidney function most accurately. Those best suited for this purpose are the Volhard[1] dilution and concentration tests. They are the easiest to perform and have best stood the test of time.

The Volhard dilution test is predicated upon the fact that normal kidneys under normal conditions will excrete fluid within three hours after it has been ingested. The test, however, is not satisfactory in the presence of edema because a large quantity of water often acts as a diuretic when it is taken after a period without fluid intake. Some of the fluid held in the tissues as edema may pass through the kidneys during the dilution test and thus increase the amount of urine obtained. This would give a false idea of the ability of the kidneys to excrete ingested fluid and would cause misinterpretation of the results of the test. If edema is present, it should be reduced by appropriate therapy—rest, magnesium sulphate, and limitation of fluids and salt. If the edema is marked and persistent, and other causes have been ruled out, one may assume that renal insufficiency is present, and the dilution test is not neces-

sary. Fever, with its associated increased loss of fluid from the skin, will decrease the amount of urine obtained and also give a false result.

For the test the following directions are given to the patient:

Take the evening meal with not over two glasses of fluid at 6 P.M.; then take no food nor fluid, except that specified, until the test is completed. At 8 A.M. the next day empty the bladder and discard the urine. Between 8 and 8:30 A.M. drink three pints of water or weak tea (if any of this is vomited, discontinue the test and start all over again that evening). At 9:30, 10:30, and 11:30 in the morning empty the bladder and save the urine. Put the three specimens together and bring them to the office. After voiding at 11:30 the test is completed and you may eat or drink as you desire.

There should be more than 1250 c.c. of urine if the kidney function is normal. Less than that amount is indicative of decreased renal function. Eleven hundred cubic centimeters would give evidence that there is beginning decrease in excretory ability, while 900 c.c. would show that marked insufficiency exists.

The concentration test is based upon the ability of normal kidneys, under suitable conditions, to concentrate urine to a high specific gravity. It has been shown by Richards[2,3] that less than 10 per cent of the fluid filtered into the glomerular spaces gets into the collecting tubules in the form of urine. The other 90 per cent, or more, is reabsorbed in the tubules. Hence, it may be stated that the primary physiologic function of the renal tubules is reabsorption. Any impairment of function of the tubules interferes with their ability to absorb fluid and to concentrate urine. Such a decrease in absorbing ability is measurable by the Volhard concentration test. This test, too, is of no value in the presence of edema.[4,5,6] For this test the following instructions are given to the patient:

Take the evening meal at 6 P.M. with not over two glasses of fluid; then take no food nor fluid until the test is completed. At 8 A.M. empty the bladder and discard the urine. At 9 A.M., 10 A.M., and 11 A.M. empty the bladder and save the urine in bottles marked 9, 10, and 11. Bring these bottles of urine to the office.

When the patient brings these three specimens to the office the specific gravity is measured. If there is an insufficient quantity in any one bottle the contents of the others may be added.

After a period of from fifteen to seventeen hours without fluid intake normal kidneys will excrete protein-free urine with a specific gravity of 1.030 or more. Freyberg and his co-workers[7] give 1.029 as the minimum. If the kidneys are normal, at least one of the collected specimens should have a specific gravity of 1.030 or more. If not, there is a decrease in kidney function. This decrease is roughly proportionate to the difference between the specific gravity obtained and 1.030. For example, if the highest specific gravity obtained were 1.022, moderate renal insufficiency would be shown, but if 1.016 were the highest obtained, it would indicate a more severe renal insufficiency. It must be remembered that any quantity of protein in the urine will raise the specific gravity above that of identical protein-free urine.[5] Specimens obtained in the concentration test should be tested for protein. If it is present in a demonstrable amount correction of the specific gravity should be made. This may be done accurately enough for practical purposes in the following manner:

Take the specific gravity of a protein-free control urine. Then add enough serum to the control urine to give a protein test qualitatively equal to the concentration specimen and repeat the specific gravity test. The difference between these two readings is due to the added protein and should be substracted from the specific gravity of the patient's urine. The result will be the corrected specific gravity for a protein-free concentration specimen.

Determination of the urea and creatinine concentration in the blood of patients with severe clinical symptoms of kidney

failure will often aid in arriving at a more accurate estimation of the kidney function.

It has been pointed out by numerous investigators,[4,8,9,10] of kidney disease that a well-marked secondary anemia nearly always accompanies chronic glomerular nephritis. This, of course, does not mean that all patients with secondary anemia have chronic nephritis, but the absence of anemia speaks against the existence of chronic diffuse glomerular nephritis of clinical significance.

Examination of the urine for albumin and sediment gives valuable information. The presence of red blood cells is evidence that an active lesion is present in the kidneys. Freshly involved glomerular capillaries bleed into the glomerular spaces. Glomerular capillaries which have been diseased a long time become hyalinized, closed, and do not bleed. The number and character of the cylindroids or casts varies as does the quantity of albumin present in the urine. While albumin is almost always present in chronic glomerular nephritis, and is found in considerable amount in the earlier stages, it may be very slight and occasionally absent in the urine of patients with disease of long duration or with nephrosclerosis. Casts, as a rule, are present in proportion to the albumin found and may be of all sorts—hyaline, epithelial, and granular. The longer the disease lasts, the fewer are the casts to be found. This is due to the fact that as the disease progresses the involved renal units become less able to secrete urine and finally cease their function, and, as a result, no albumin nor casts are produced.

Edema, oliguria, or hypertension in the presence of chronic glomerular nephritis or nephrosclerosis should be considered evidence of renal insufficiency until proved not to be. At times the only symptom presented by the patient is hypertension, while at other times hypertension is an accompanying symptom. It is extremely important to know whether the hypertension is due to arterial spasticity or to arterial or arteriolar disease, and in this connection ophthalmoscopic study of the retinae is important. If there is evidence of arteriolar change in the retinae, generalized arteriolar change may be expected elsewhere, including the kidneys. Other things being equal, renal arteriolar sclerosis of any degree will diminish the concentrating ability of the kidneys, while pure vascular spasticity will not.

Stander and Peckham[11] have written: "The absence of albuminuria, edema, symptoms and signs of decreased kidney function in the presence of a hypertension, does not speak against the existence of an underlying or developing chronic nephritis. The term 'essential hypertension,' as denoting no kidney damage, is a dangerous one to employ, as the hypertension may be the first sign to precede the development of serious renal impairment dependent upon arteriosclerotic changes in the kidney."

Huber[12] has shown that 99.5 per cent of the blood to the kidney passes through the glomerular capillaries before going to the rest of the kidney. Hence, if there is arteriolar disease the tubules must suffer as a result.

Stander and Peckham[11] and McKelvey and MacMahon[13] have pointed out that the maternal mortality due to chronic nephritis or nephrosclerosis, if studied over a ten year period, is about 40 per cent. That is, 40 per cent of the women with chronic nephritis die within ten years of becoming pregnant. Therefore, even if such a woman should survive pregnancy, labor, and the puerperium, her life expectancy has been enormously shortened. One cannot disregard this ten year 40 per cent maternal mortality in patients who show physical signs of kidney disease during pregnancy. As one studies the case histories presented in the excellent article by McKelvey and MacMahon, he is impressed by the fact that during pregnancy each patient showed demonstrable symptoms of arteriolar disease, renal insufficiency, or acure lesion in the kidney. Any of these symptoms demands immediate termination

of the pregnancy in order to prevent added damage to seriously diseased kidneys. The patient with concealed nephritis, however, presents a more complex problem.

Flexibility must characterize the management of a pregnant woman with suspected renal damage as pregnancy adds to the renal burden. At times a woman with damaged kidneys, but with no demonstrable renal insufficiency, will become pregnant. As the pregnancy progresses, periodic tests of the renal function may show a beginning, and occasionally increasing, renal insufficiency. If such is the case, the anticipated risk has become a factor to be considered for, as a rule, the kidney function tests will demonstrate renal insufficiency before symptoms appear. Should renal insufficiency increase from week to week, termination of the pregnancy becomes imperative if the mother's health is to be safeguarded. This should not be postponed until actual evidence of the kidney failure is manifested by anasarca, retention of urea and creatinine, or marked arterial change, since added permanent damage would, by this time, have been done to the maternal kidneys. Instead, clinical symptoms should be anticipated by frequent kidney function tests in the suspected individual, and the results of the tests should govern the treatment. *There is no more reason to wait for actual physical signs of kidney failure in a patient with chronic nephritis before terminating the pregnancy than there is to wait for demonstrable axillary metastasis before removing a cancer of the breast.*

Women without clinical symptoms of decreased renal function, but with laboratory findings of slight renal insufficiency, may be allowed to continue pregnancy if frequent tests are made to determine any increase in renal failure. The patient must be made to understand her condition and to realize that if during pregnancy there is evidence of increasing renal failure, her pregnancy will be terminated.

Pregnancy may safely continue in patients who have no clinical symptoms of kidney insufficiency if renal function is normal as shown by the concentration and dilution tests.

The factor which determines the nephritic patient's risk is her renal function. If this is normal, as demonstrated by absence of symptoms of renal insufficiency and by the concentration and dilution tests, pregnancy may be allowed. If there are symptoms of renal insufficiency, or if the results of the concentration and dilution tests are conspicuously below normal, pregnancy is contraindicated.

No one can say what amount of kidney tissue must be destroyed in any individual before there is demonstrable decrease in kidney function. It must be admitted, however, that varying amounts of renal tissue may be rendered permanently useless without preventing the kidneys from carrying out all physiologic demands with perfect efficiency. *It is the presence of sufficient normally functioning kidney tissue to carry on without any embarrassment all of the demands put upon it by pregnancy that determines the safety factor of the patient.* The hazard which pregnancy entails to a woman with diseased kidneys can be determined by a careful correlation of the ascertainable factors.

SUMMARY

An accurate estimation of the kidney function should be made in every pregnant patient with nephritis or with toxemia of pregnancy. This can be done by correlating the symptoms and laboratory findings with the Volhard water tests. The kidney function should be estimated at frequent intervals, both during and after pregnancy, when a woman is suspected of having kidney disease. It is the presence of sufficient normally functioning kidney tissue to carry on without any embarrassment all of the demands put upon it by pregnancy that determines the safety factor of the patient. If there is insufficient normally functioning kidney tissue present for this purpose, the pregnancy should be terminated in order to

safeguard the life and future health of the mother.

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TRANSPERITONEAL EXCLUSION CESAREAN SECTION

THROUGH THE LOWER UTERINE SEGMENT

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PROBABLY no operation in the history of medicine has a more ancient and fascinating history than that of cesarean section. Its growth and development have extended over many hundreds of years and while this maturing process has left in its wake a disastrous trail of maternal mortality, from it has emerged a technique which has been life saving to both mother and child.

The earliest history of cesarean section dates back to about 700 years B.C. The operation was referred to by the early Egyptians, and the Lex Regia of Numa Pompilus commanded the removal of the child before the burial of the mother. The fact that Felkin, an African traveler, witnessed a cesarean operation in Africa in 1879, would lend credence to the fact that the operation was not unknown to the natives of that country at an early period.

About 1500, one J. Nufer of Switzerland, a swinegelder by profession, delivered his own wife by section, after many midwives and barbers had attempted delivery. Then in 1581, F. Rousset published a report of fifteen cases of cesarean section, but it is not unlikely that a number of these deliveries were extra-uterine pregnancies.

The first authentic and accepted cesarean section on a living woman was performed by J. Trautman of Wittenberg in 1610, and amazing as it may seem, very little progress was made from that time for over a period of two hundred years. Because of the appalling mortality the cesarean operation was only used as a last resort, the effort being directed primarily towards saving the child and, hopefully, the mother.

Porro, in 1877, because of the high mortality, advised amputation of the body of the uterus. This operation became generally accepted and popular; it remained in vogue until Sanger in 1882 revolutionized cesarean section by describing an accurate technique and insisting on certain cardinal principles of modern surgery. With the improvement in technique, the Sanger operation made rapid strides and soon became recognized as the accepted procedure, displacing to a great extent the more radical operation of Porro.

It soon became evident, however, that the classical section, while a great step forward, did not solve the problem of the patient with an infected uterus, as the very nature of this operation, being intraperitoneal and intra-abdominal, invited bacterial invasion rather than protected the abdominal cavity against it. Prior to Sanger's accomplishments, accoucheurs had attempted to perform an extraperitoneal operation. In 1809, Joerg proposed a flank incision and in 1821 Ritgen performed this operation. Baudelocque, in 1823, and Physic of Philadelphia, in 1824, also recommended an extraperitoneal section. Gaillard Thomas, in 1871, revised the operation known as laparoelytrotomy and reported thirty-two cases, but later abandoned the operation in favor of the classical section.

It was not until 1906 that Frank[2] of Bonn, suggested his extraperitoneal delivery. Dissatisfied with the classical operation and its results in women who were either infected or potentially so, Frank was led to experiment with various incisions. The results of his observations showed that the lower uterine incisions were more prone to drain into the "vesico-uterine excavation" than were the higher incisions. This fact and his preference for the deep transverse uterine incision of Kehrer were undoubtedly factors in influencing him

in his original extraperitoneal operation. Frank's procedure was as follows: "Following a transverse incision of the abdominal wall, the vesico-uterine plica was incised transversely to the same extent. The wound margins of the parietal and visceral peritoneum were sutured; under these conditions a given portion of the uterus remained situated extraperitoneally and in this region the incision was made."

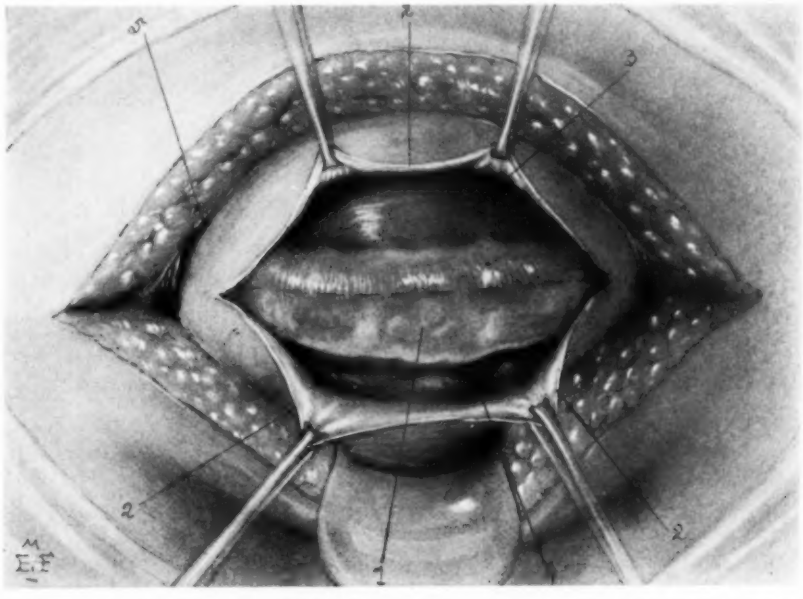

Fig. 1. *1*, Uterovesical fold of peritoneum—injected with sterile saline solution. *2*, Parietal peritoneum. *3*, Uterus. *4*, Bladder. *5*, Fascia, cut transversely.

In 1908 Sellheim[3] attempted to improve on Frank's operation and suggested a true extraperitoneal operation by dissecting the peritoneum from the vertex of the bladder inferiorly. In cases where this was not practical, Sellheim also incised the peritoneal flap, attached to the bladder, and sutured the defect in the plica vesico-uterina. This he combined with the abdominal wall incision of Pfannensteil.

Many other operators suggested changes in Frank's technique, but these were mainly in the direction of the uterine incision.

The main dangers attending Frank's operation seemed to be the occurrence of abdominal hernia, hemorrhage during operation, and the time element involved. Veit theoretically obviated these dangers by advocating a longitudinal incision, both in the abdominal wall and in the lower uterine segment.

To avoid all these difficulties and dangers and to perform a truly extraperitoneal operation that would not in any way open the peritoneal cavity, Latzko[4,5,6] offered his extraperitoneal cesarean section, and on April 26, 1908 employed this operation for the first time. The technique consisted of filling the bladder with fluid and displacing it laterally to expose the thin distended cervix in the preperitoneal cavity. A midline incision was then made in the uterus, and this was followed by the delivery of the child.

The various types of extraperitoneal operations seemed to present so many technical difficulties that they gradually fell into disuse and were employed only by the occasional operator. Veit,[8] however, appreciative of the necessity of an operation that would be of value in the infected cases and also an operation that would fall into the realm of the ability of most surgeons, suggested in 1913 a procedure in which the uterus was brought out of the abdominal cavity, carefully covered with moist towels, emptied quickly in order not

to spill the uterine contents, and then returned to the abdomen. While this operation solved certain problems it produced

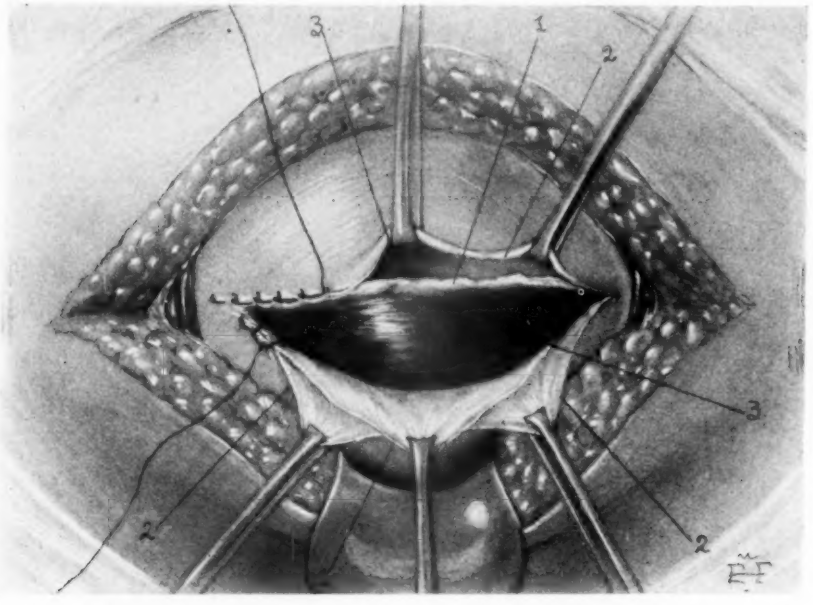

Fig. 2. *1*, Uterovesical fold of peritoneum; upper and lower incised portion. *2*, Parietal peritoneum. *3*, Uterus.

others, mainly on account of the adhesions which inevitably formed during postpartum convalescence.

Gottschalk of Germany and Portes of France went a step further and temporarily exteriorized the uterus until all infection had subsided. The uterus was then either returned to the abdomen or amputated. Kronig contended that the main factor in the infected cases was not so much the initial uterine spill, but the seepage that occurred a few days later, and that the factor of safety, in the extraperitoneal operation was the placing of the incision in the lower uterine segment where it could be covered by peritoneum. Kronig's technique placed the uterine incision in the midline and extended well down into the lower uterine segment. Gellhorn of St. Louis modified this operation by uniting during the operation the parietal and visceral layers of the peritoneum, thus shutting off temporarily the abdominal cavity.

Beck and De Lee, with minor modifications of the Kronig operation, have done much to popularize the low cervical cesarean section in this country, and since Beck's first description of his two-flap low incision section in February 1919, many operators have adopted this type of operation in preference to the classical section.

Obstetricians who have followed this method feel that there are distinct advantages in the low segment operation over the classical, which might be cited as follows: (1) less blood loss; (2) less shock; (3) the advantage of a retroperitoneal closure of the uterus; (4) a better scar for future pregnancies; and (5) a decidedly lessened danger of peritonitis.

It has been demonstrated recently in the Budeloque clinic, that at least 60 per cent of women, even when no examination has been made, show bacterial contamination of the amniotic fluid three hours after the membranes are ruptured. This being true, it is only a natural conclusion to assume that the less seepage there is and the more it is controlled in cesarean sections, the less chance there is of peritonitis.

While it has been definitely shown that the low uterine segment operations have done more than any other type of operation to reduce maternal mortality and morbidity, they lack, however, that margin

of safety that the extraperitoneal and peritoneal exclusion operations provide in the infected and potentially infected cases. remain, however, a highly specialized operation, and in many operators' hands will carry a high morbidity if not mortality.

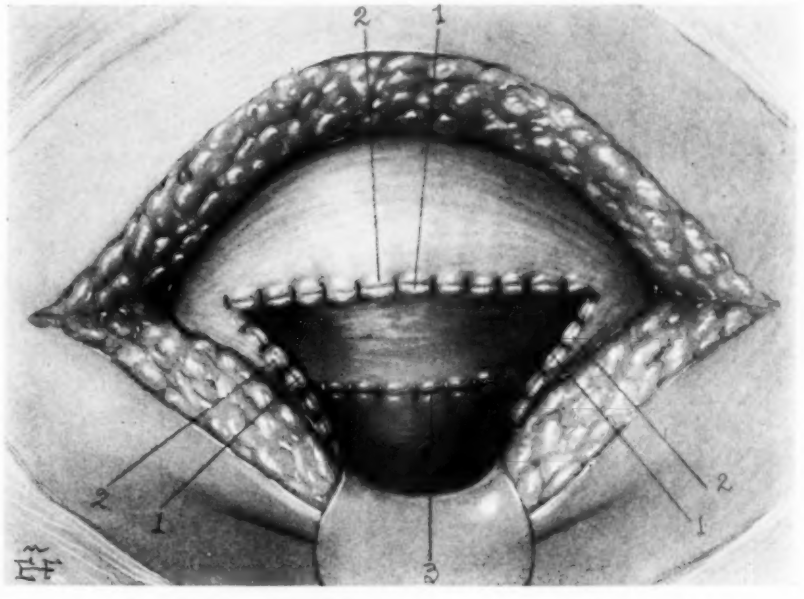

Fig. 3. *1* and *2*, Uterovesical fold of peritoneum; vesical and parietal layers of peritoneum sutured together. *3*, Transverse incision in lower segment of uterus sutured.

Of the peritoneal exclusion operations the Veit-Fromme-Hirst section is perhaps the best known. It carries a low mortality rate. Phaneuf[15] cites sixty-four cases with a mortality of 7.8 per cent and states that these deaths were due mainly to causes other than peritonitis. The Latzko operation is probably the operation of choice in severely infected women. Jellinghaus in 1923 revived this operation at the New York Lying-In Hospital, and since that time it has enjoyed an increasing popularity. Steele[12] and Burns[13] in 1930 published their results of the Latzko operation, Steele reporting an analytic study of fifty-nine cases. In 1934, Burns[14] reported a further study of seventy-nine patients delivered by the Latzko method. Aldridge[17] has also recently published a report of a series of cases of the Latzko operation with a modification of technique in incising and suturing the uterovesical fold of peritoneum, thus providing for more room in the delivery. While this operation is highly desirable in many cases, it must long

In an effort to attain as closely as possible the margin of safety that the Latzko operation gives and also to secure the advantages of the transverse low segment operation, the following technique of a modification of the original Frank operation is described.

This operation places in the accoucheur's hands a cesarean section that presents no great technical difficulties as its technique is practically that of the low transverse segment operation.

The Pfannenstiel incision gives adequate room and exposure and brings the incision directly over the uterovesical fold of peritoneum. By doubly suturing the peritoneal layers the abdominal cavity is sealed above and below. This allows the uterine incision to be placed entirely in the lower segment, entirely covered by peritoneum. It provides for the natural point of drainage into the cervix, and adds to the usefulness of the transverse low segment operation by rendering it more safe through the exclusion of the abdomen if

desired. It is not contraindicated in placenta previa.

TECHNIQUE

Step I. The anesthesia may be general, spinal or local. Local anesthesia is preferable in toxic cases. Two per cent novocaine is used in the skin and 1 per cent novocaine in the peritoneum and uterus. A basal anesthetic should be given prior to the local anesthesia. Nembutal gr. 4½ gives good results.

The patient is catheterized, preferably in the operating room, to insure complete emptying of the bladder.

Step II. At the level of the anterior-superior spines, a Pfannenstiel incision 4½ inches in length is made. The fascia is separated from the muscles both upwards and downwards to insure plenty of fascial retraction. The muscles are divided in the midline and separated, exposing the peritoneum. The peritoneum is opened transversely to a point sufficient to expose the uterus adequately.

Step III. The uterovesical fold of peritoneum at its loose attachment is now picked up with plain forceps and injected both to the right and to the left with 1 per cent novocaine, if local anesthesia is being used, or sterile saline solution in case of spinal or general anesthesia. A long wheal of peritoneum will be raised. This is incised with scissors, leaving a sufficient margin of peritoneum both above and below for suturing purposes. The bladder is now dissected away from the anterior surface of the uterus for a distance of 5 cm., or about 2 inches, thus exposing the lower segment.

Step IV. The upper parietal peritoneum is now doubly sutured to the upper portion of the visceral peritoneal flap, using a No. 1. chromic intestinal suture. This suture starts from one end of the peritoneum and is carried to the opposite side. A reinforcing suture with invagination of the peritoneum is now applied. The lower edges of parietal and visceral peritoneum are sutured in the same manner, and are joined at either end to the first line of suture, thus entirely shutting off the abdominal cavity. A Doyen retractor is placed in the lower angle of the wound and the lower segment is exposed. A strip of two-inch iodoform gauze is placed across the upper sutured layer of peritoneum to protect this area from the excess of the uterine spill.

Step V. A small transverse incision is made in the lower segment and the suction tube is introduced, removing as much amniotic fluid as possible. The incision is now enlarged transversely by means of bandage scissors, gently curving the incision upwards at either end, while T clamps are applied as the incision is made. A small vertical incision at the midpoint of the transverse incision will give added room if necessary. As the incision is made, 5 c.c. of pituitrin is injected into the uterus, and a hypodermic of ergotrate is given intramuscularly.

The child is delivered by inserting the hand carefully under the lower flap and raising the presenting part, at the same time exerting pressure on the fundus. The blade of a forcep used as a shoehorn will also aid the delivery, as will the application of small forceps. The placenta will generally become detached as the uterus contracts.

Two Kocher forceps placed at either angle of the wound will insure proper approximation of the edges. Interrupted sutures are placed and second row of continuous No. 2 chromic is added.

Drainage of the retrovesicular area is optional, but, if desired, it may be established according to the method suggested by De Lee or that of Aldridge in his modified Latzko operation. A small cigarette drain is placed between the bladder and the lower uterine segment. This drain passes out through the midportion of the uterine incision where it is sutured by No. 0 catgut. The lower end is carried out into the vagina. It is allowed to remain for seven days and is removed through the vagina.

Step VI. The lower reflected flap of the sutured visceral parietal peritoneum is now carried up and sutured to the upper to retract into the wound and remain. This will give added strength to the wound.

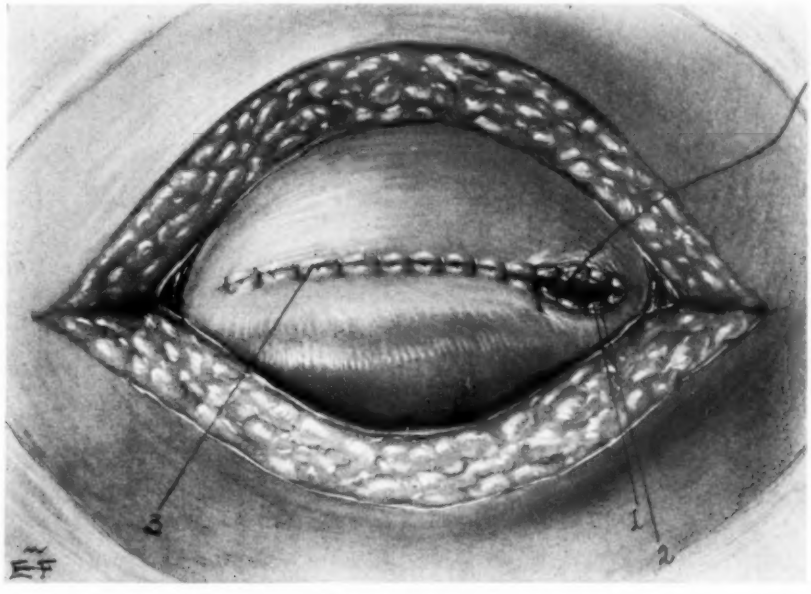

Fig. 4. *1* and *2*, Sutured layers of vesical and parietal peritoneum. *3*, Closure of united vesical and parietal layers.

united visceral parietal layer, by a few interrupted catgut sutures.

Step VII. The muscles are now allowed to fall together in the midline and may be approximated by one or two loose catgut sutures. The fascia is grasped at either end by skin hooks or Kocher artery forceps and a running No. 3 kaldermic suture is started through the skin at one end and carried through the fascia as a running mattress suture, emerging at the opposite end from the skin. When this suture is pulled taut, it snugly approximates the fascial edges. A similar suture is placed starting through the skin as before, but below the first. This includes the superficial fascia and again emerges from the skin below the point of the first emerging suture. After the skin is closed, the two suture ends at either end of the wound are tied over a gauze toll. The sutures are removed by cutting both at one end, iodinizing them and drawing them out twelve days later. It is better to cut them on the tenth day, and remove them on the twelfth day. The sutures may also be cut off at either end, allowing the ends

CONCLUSIONS

The potentially or actually infected case must have an operation which will exclude the peritoneal cavity.

Such an operation is described. It not only excludes the peritoneal cavity, but gives the advantages of the transverse cervical or low segment operation.

The transverse cervical operation may be converted into a peritoneal exclusion operation without a necessary change of technique.

This operation provides for the natural point of drainage, that is, into the vaginal canal.

The operation lends itself to local anesthesia if desired.

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Pain caused by moving the cervix, even slightly, with the examining fingers is common in ectopic pregnancy and to a lesser extent this symptom may be elicited in parametritis and cellulitis.
From—"Diseases of Women" by Paul Titus (National Medical Book Co.).

INTRAVENOUS ANESTHESIA IN OBSTETRICS

A COMPARATIVE STUDY OF PENTOTHAL AND EVIPAL SOLUBLE WITH A REPORT OF 250 CASES

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THE patent advantages of intravenous anesthesia in certain restricted surgical fields has been adequately presented in the world literature. The paramount, demanded characteristic of any anesthetic agent is safety, and recent advances in the preparation of certain barbiturates have endowed intravenous anesthetic drugs with a wide margin of safety. The wide usage of evipal soluble and the careful studies of large series of cases in which it has been employed indicate that in proper hands, properly administered, it is as safe an anesthetic as is known. Pentothal, an agent more recently developed than evipal, is stimulating similar reports in the literature and it, too, is gaining wider employment. Our interest in these drugs was aroused by the possibility of finding in them a more satisfactory anesthetic agent to be used obstetrically. We have previously reported an experience with evipal in both operative and spontaneous delivery. Since the appearance of that report we have continued our studies, enlarging our series of cases to about 250, equally divided between evipal soluble and pentothal. We have had an opportunity of making accurate, clinical comparisons between the drugs and the information gleaned from such comparison is here included.

Chemically and pharmacologically pentothal and evipal present similarities. Both drugs are rapidly destroyed in the body, probably by the liver. This fact points out a contraindication, namely, liver disease, and in obstetrics the toxemias of pregnancy and sepsis. Neither drug affects blood chemistry, with the exception of some practically negligible elevation of blood sugar. Blood pictures are unaltered. Metabolism is not affected. With anesthetic doses both drugs will produce a moderate respiratory depression which is not alarming and which will not produce clinical signs of anoxemia. The vasomotor effects of the drugs are at marked variance. Evipal almost invariably brings about an increase in pulse rate and a fall in blood pressure, while pentothal, almost as consistently, will effect an elevation of pressure and will leave the pulse rate unaffected or somewhat slowed. Other pharmacologic characteristics have no clinical bearing.

Pentothal and evipal are powders, and both are sodium salts and readily soluble in water. The drugs are prepared in ampoules containing 1 Gm. Pentothal is best dissolved in 20 c.c. of water, giving a 5 per cent solution, while evipal is dissolved in 10 c.c. of water, producing a 10 per cent solution. The evipal as prepared for use is colorless and clear, while pentothal is a yellow tinged solution, similarly clear. When the solutions have been prepared, turbidity contraindicates their use and fresh solutions must be resorted to. The dosage (advised maximum) is 1 Gm. of the crystals.

Administration is by vein, preferably one of the vessels in the cubital fossa. Injection should be slow. We have repeatedly found that 4 to 5 c.c. of either drug produces surgical anesthesia. Because of the vasomotor reaction to evipal, it is advisable to inject more slowly than with pentothal. Thus anesthesia should be reached with evipal in sixty to ninety seconds while pentothal safely attains the same stage in

thirty to fourty-five seconds. The depth of anesthesia is not a corollary of larger dosage. Maximum anesthetic depth is reached with the doses noted and further administration of the drug merely serves to prolong the anesthetic stage. The anesthetist, therefore, injects the agent until surgical anesthesia is reached; then maintains his needle in position in the vein until signs indicate further injection.

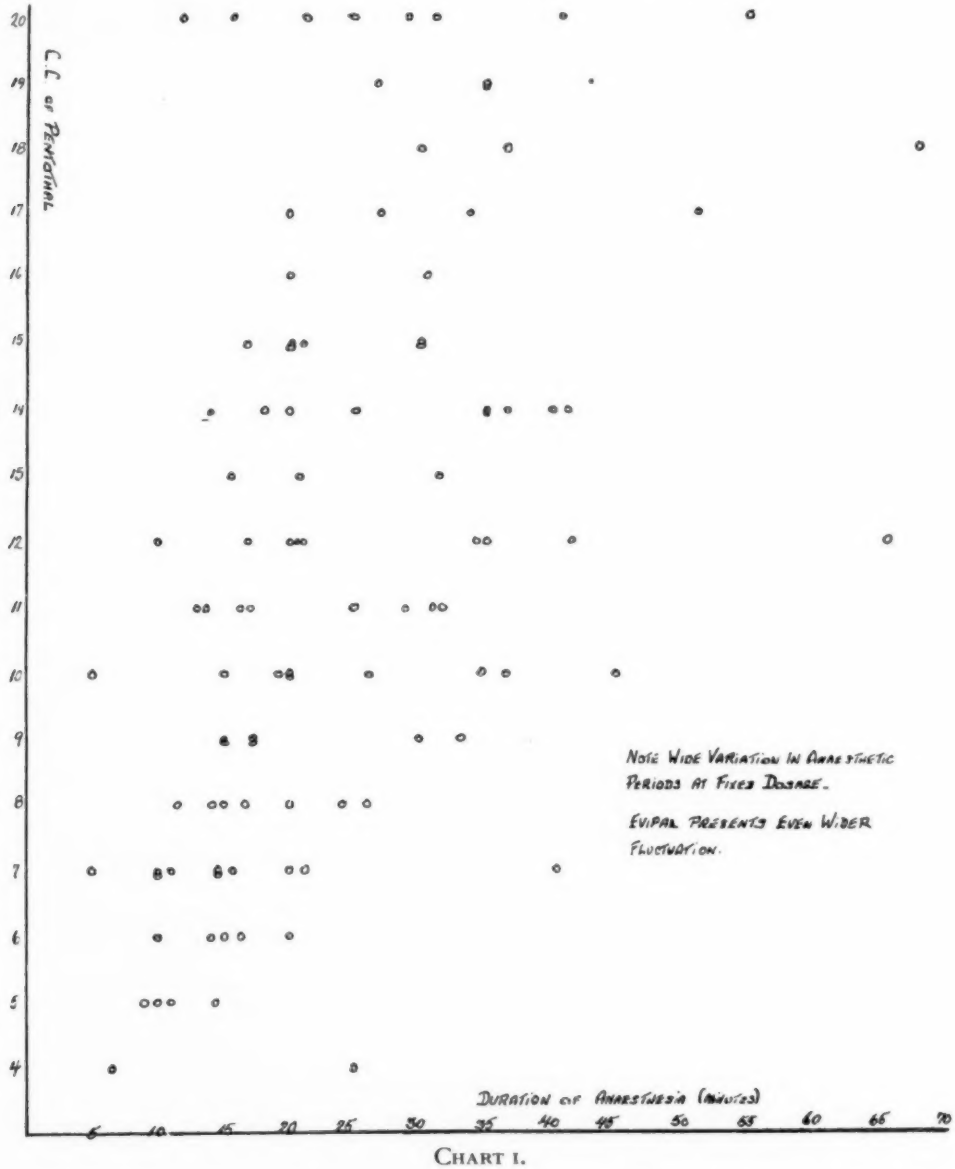
C.C. of Pentothal
Duration of Anaesthesia (minutes)
Note Wide Variation in Anaesthetic Periods at Fixed Dosage.
Evipal presents even wider fluctuation.

Chart 1.

The duration of anesthesia at given dosages is extremely variable. We have been unable to fix any relationship between duration and such factors as age, weight, general condition, hemorrhage, race, etc. Chart 1 graphically illustrates this point. There is marked individual susceptibility to the action of the drugs and this must ever be in the mind of the anesthetist. It should be a fast rule to proceed on the smallest possible dosage. This will assure the widest possible factor of safety.

Induction of anesthesia with pentothal or evipal is a quiet event. Excitation is unknown. This is particularly true of pentothal, which has eliminated even the muscle spasms and twitchings so commonly seen in evipal induction. An incredibly

brief time after injection of either drug, the patient is surgically anesthetized. Under anesthesia, the patient exhibits variations oscillation until the anesthetic begins to wear off. Under both drugs the lid reflex is completely obliterated.

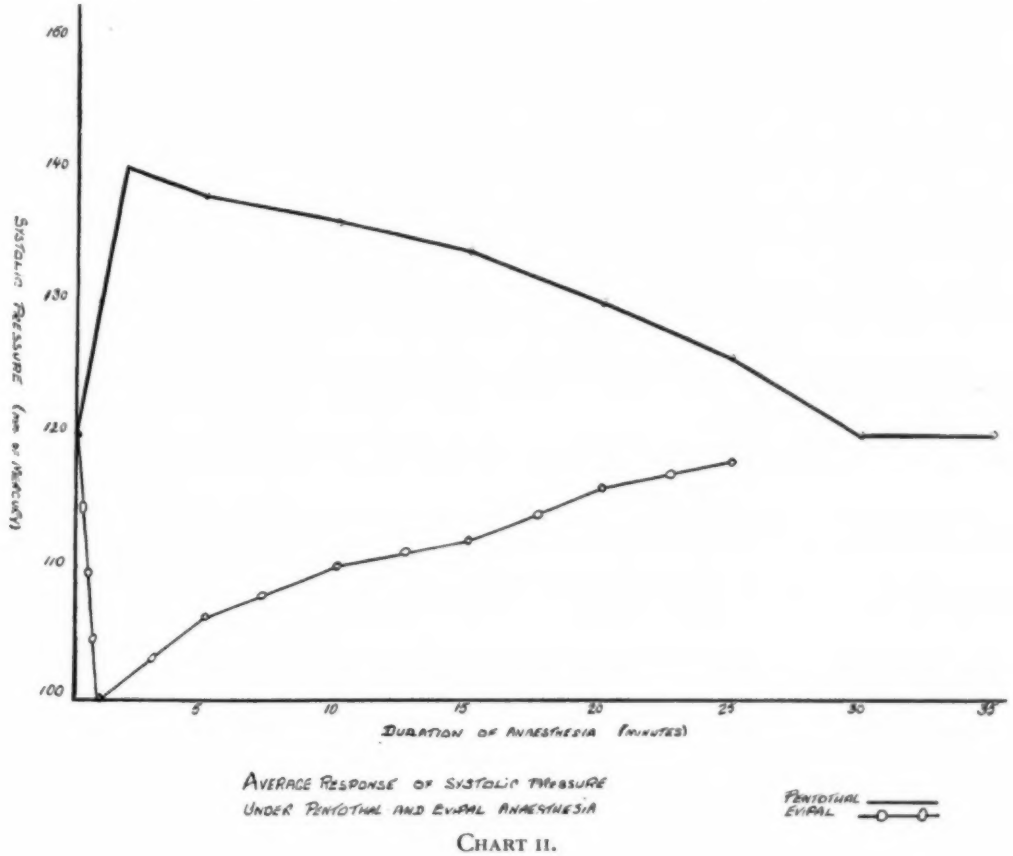

Chart II.

when the two drugs are compared. The vasomotor effects have been stated and charts 2 and 3 illustrate these. Pentothal has a great advantage in its vasomotor action. Both drugs depress respiration, but in our experience, respiration is audible and stertorous in 50 per cent of cases anesthetized with pentothal. We have never heard the respiration when using evipal. Certain observers have suggested placing a wisp of cotton over lips and nose to be used as a guide to the character of the breathing. We have never found this essential.

Eye signs differ under the two drugs. Chief variation is in the pupil. Evipal always causes wide pupillary dilatation while pentothal rarely causes more than mid-dilatation. Both drugs fix the eye in mid-position where it remains without

In the obstetrical field there are common advantages. The speed of induction, the ease of administration, and the fact that preparation of the patient for anesthesia is unnecessary, are common to both drugs. Over a series of 250 cases, neither has produced respiratory difficulty or asphyxia in the newborn. We have never seen the case in which either drug could be held responsible for post-partum hemorrhage. Uterine contractility and uterine contractions are not impaired by either drug. Pentothal will, in approximately 60 per cent of cases, efface the bearing down efforts. This is a disadvantage in spontaneous deliveries. In operative deliveries it may serve as an advantage to some operators, while to others it might be objectionable. Evipal has no affect on bearing down efforts.

TABLE I

COMPARATIVE ANALYSIS OF PENTOTHAL AND EVIPAL SOLUBLE
(Based on a comparative series of 250 cases)

	Pentothal	Evipal Soluble
Chemistry.	Sodium salt of ethyl (1-methyl butyl) thiobarbiturate.	N-methyl-cyclohexenyl-methyl-malonyl-urea (sodium salt).
Preparation.	1 Gm. of crystals dissolved in 20 c.c. of distilled water. Solutions must be fresh.	1 Gm. of crystals dissolved in 10 c.c. of distilled water. Solutions must be fresh.
Administration.	Intravenous: No more than 4–5 c.c. in thirty seconds to induce anesthesia. When surgical anesthesia is attained further injection is performed as indicated by the status of the patient.	Intravenous: 4–5 c.c. in 60–90 seconds to induce anesthesia. When surgical anesthesia is attained, further injection is performed as indicated by the status of the patient.
Speed of anesthetization (Surgical).	30–45 seconds without danger.	60–90 seconds without danger.
Duration of anesthesia.	Variable: maximum in this series with a 1 Gm. dose: 68 minutes. No relation of dose to duration in the individual patient. Average duration, doses from 4–20 c.c.—23 min.	Variable: maximum in this series with 1 Gm. dose: 25 minutes. No relation of dose to duration in the individual patient. Average duration, doses 3.5–10 c.c. 12 min.
Maternal effects		
(a) Blood pressure.	Most commonly a moderate rise of pressure with a gradual return to normal. More rarely the pressure is unaffected or exhibits a fall of no more than 5–10 mm., with rapid return to normal.	Commonly a fall varying from 15 to 20 mm. with a gradual return to normal. More rarely the pressure remains level. In this series no pressure elevation was seen.
(b) Pulse.	Commonly remains unaffected or is slowed. Rarely increased in rate.	Usual rate increase with return to normal with cessation of anesthesia.
(c) Eye signs.	Eye is fixed in mid-position with lid lag marked. Pupil rarely at or beyond mid-dilatation.	Identical with pentothal except pupil which commonly is widely dilated.
(d) Respiration.	Depressed moderately in depth. Rate of respiration unaffected.	
(e) Uterine contractions and contractility.	Respiration audible in 50 per cent of cases. Unaffected.	Respiration generally inaudible. Unaffected.
(f) Bearing down "reflex."	Obliterated in 60 per cent of the cases.	Unaffected.
(g) Hemorrhage.	No tendency toward production of increased bleeding in the third stage.	No tendency toward the production of increased bleeding in the third stage.
Fetal effects.	No apparent effect in the fetus. Respiratory difficulty not encountered.	No apparent effect in the fetus. Respiratory difficulty not encountered.
Induction.	Rapid; uncomplicated; no excitation; no muscle spasm.	Rapid; uncomplicated; generalized or localized muscle spasm is common.
Recovery.	Rapid. "Hangover" common hence patients may remain drowsy for two to three hours.	Rapid. Clarity generally present in one hour. Occasional persistent drowsiness.
Post-anesthetic complications.	Rare; vomiting unusual.	Rare; vomiting unusual.
Urinary or blood reactions.	None.	None.
Obstetric contraindications.	Toxemia. Version. Sepsis.	Sepsis. Toxemia. Version. Any procedure which may require an anesthetic period exceeding 20 minutes.
Pharmacology.	From the practical viewpoint pharmacologic characteristics are identical. There is some variation in the lethal dosage in the experimental animal. Both drugs are rapidly destroyed, probably by the liver. Both drugs produce death by respiratory depression and arrest. Neither depresses metabolism, temperature, alkali reserve or blood sugar.	
Denarcotization.	Rapidly accomplished by use of metrazol or coramine.	Rapidly accomplished by use of metrazol or coramine.
Respiratory depression or cessation.	Artificial respiration; carbon dioxide and oxygen; picrotoxin; coramine; metrazol.	Artificial respiration; carbon dioxide and oxygen; coramine; metrazol.

Variation in duration of anesthesia has been mentioned. Evipal will produce, at the maximum, twenty-five minutes of anesthesia. We have seen one case in which a single dose of pentothal gave an anesthetic period of sixty-eight minutes. The duration of anesthesia is always longer with pentothal which is a tremendous advantage. To exceed the normal maximum anesthesia with evipal implies multiple dosage. We cannot advise the use of more than 1 Gm. of evipal, as dosages exceeding 1 Gm. limit the margin of safety. When the normal dose of evipal is exhausted the operator is safer supplementing with an inhalation anesthetic or by local infiltration. This will rarely, if ever, be necessary when pentothal is used.

Table II
OBSTETRIC PROCEDURES PERFORMED UNDER INTRAVENOUS ANESTHESIA
(Pentothal and Evipal)

Low Forceps (including episiotomy and repair, or repair of lacerations of first or second degree)
Mid Forceps (Mid-A, Mid-B, Kielland rotation, Scanzoni maneuver, manual rotation)
Breech Extraction (delivery of the after-coming head by Piper forceps, Smellie-Veit maneuver, Martin-Wiegand maneuver)
Examination under narcosis
Dilatation and curettage
Manual removal of the placenta
Packing of uterus and vagina
Spontaneous delivery
Procedures Attempted Without Success
  Version
  Cesarean section

In our earlier work with evipal it was our custom to place the patient on the table, cleanse the obstetrical field, catheterize, and examine obstetrically before proceeding with the injection. This was essential to completion of procedures under evipal. The short action of the drug made it necessary to spare no effort to conserve time. Pentothal obviates this. The procedures required may be performed at a more leisurely pace after the patient is anesthetized. Thus the injection is begun, and preparation, catheterization and examination follow. The operative procedure is then started.

The comparative table (Table 1) was derived from data collected from 250 operative deliveries. In addition to operative procedures we have used these drugs as indicated in Table II.

Of our series of 250 operative deliveries certain facts may be quoted: the oldest patient was 39, the youngest 15. Ninety-seven per cent of the patients were colored. The pentothal cases, where there was no technical difficulty in injection, never required supplementary anesthesia. Evipal required supplement in 15 per cent of the cases. There was no maternal or fetal mortality due to the drugs. One fetal death occurred following impaction of the shoulders, requiring the use of the Braun hook for completion of the delivery. Seventy-four per cent of the patients were primiparae. In the group, low forceps and episiotomy and repair were the commonest procedures. There were no post-anesthetic complications. Vomiting was seen rarely, and the cases in which it occurred more commonly were anesthetized with evipal. The average duration of anesthesia under pentothal was twenty-three minutes, under evipal twelve minutes. Recovery was more rapid with evipal. Pentothal left the patients drowsy for from one to three hours. Certain operators might consider this advantageous. In no instance was any great difficulty in resuscitation of the newborn encountered. In no case were alarming signs noted in the mothers. Post-partum hemorrhage occurred four times. Three of the cases were under evipal, but we hold this to be coincidental. Neither drug inhibits uterine contractility. The series included one decompensated rheumatic cardiac, one severe pyelitis and one status asthmaticus. In this last case we ruled respiratory difficulty from our list of contraindications.

We have never been able to perform cesarean section under these drugs. We have met with failure each time we have attempted version. We cannot obtain adequate relaxation for either procedure. Various operators have had no difficulty

with abdominal procedures under intravenous anesthesia. In our hands it has failed.

and oxygen have a similar effect, and these agents should be employed in the event of respiratory collapse. Artificial respiration

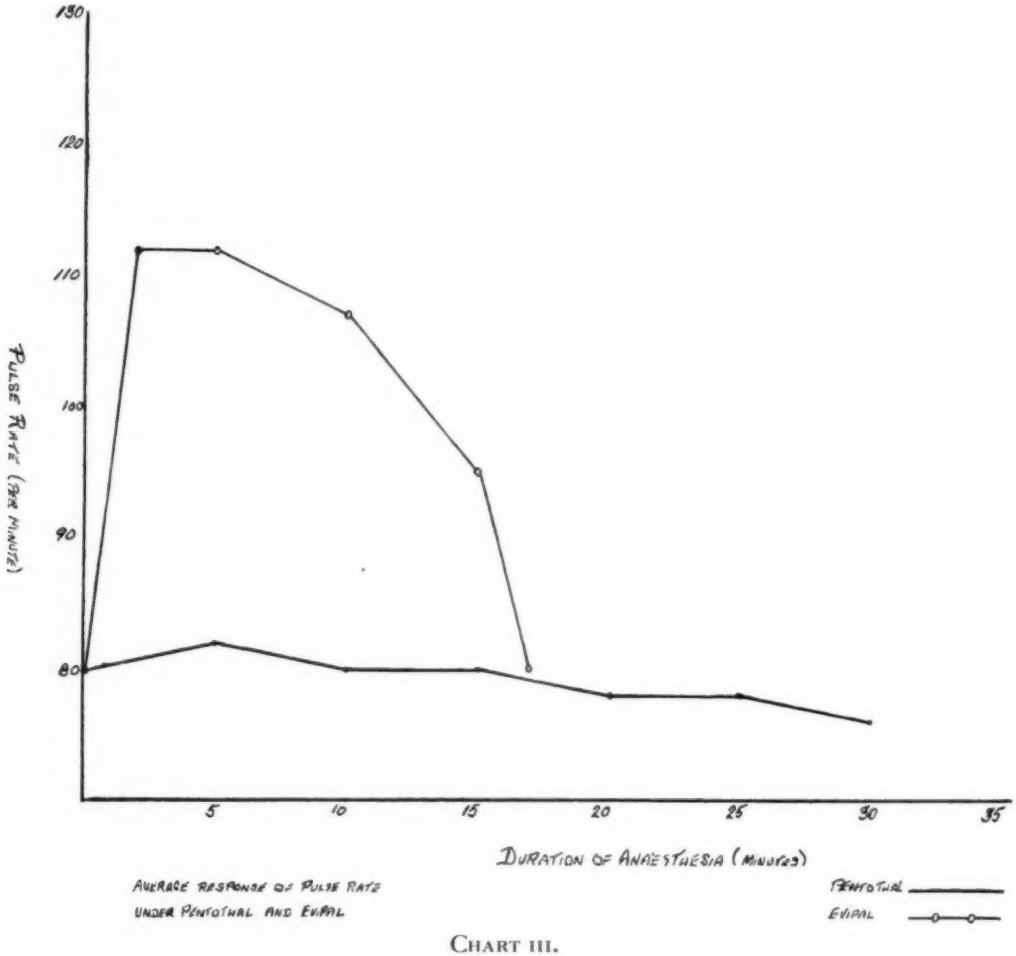

Chart III.

Intravenous anesthesia carries tremendous advantages for the obstetrical operator; we have previously detailed these findings. After our experiences with both drugs we consider pentothal to be the superior agent, by virtue of its more salutary affect on the vasomotor system, its more prolonged action, and its tendency to permit the occurrence of audible respiration.

While we have never seen alarming symptoms or signs in an anesthetized patient, we have found that denarcotization may be rapidly accomplished by the intravenous administration of coramine or metrazol. These drugs should be used in doses of from 3 to 5 c.c. Carbon dioxide is, of course, indispensable. From our observations we feel certain that proper administration and proper dosage, in cases presenting no contraindications, will never result in difficulty.

General contraindications to pentothal and evipal are similar: liver disease, sepsis, debility, etc. Obstetrically the drugs are contraindicated for version and in toxemias (the rôle of the liver in the toxemias must be remembered). Unless the operator desires to supplement anesthesia, evipal is contraindicated where it is expected that the operative procedure may exceed twenty or twenty-five minutes. Analgesia produced by the usual agents employed (nembutal, scopolamine, morphine, ether-in-oil, paral-

dehyde, etc.) does not contraindicate the use of evipal or pentothal. We have used pentothal for delivery in cases in which analgesia was produced with doses of nembutal up to 9 gr. We have used pentothal where nembutal and paraldehyde by rectum had been used. No ill effects have been seen.

CONCLUSIONS

1. Pentothal and evipal have been used in a series of 250 obstetric operative procedures.

2. The characteristics of the drugs are recorded.

3. Pentothal has been found to be free of depressant action on the vasomotor system.

4. Pentothal produces more prolonged anesthetic periods in doses equal to those of evipal.

5. Obstetrically, where an intravenous anesthetic is to be employed, pentothal is the agent of choice.

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THE SURGICAL TREATMENT OF SYRINGOMYELIA*

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BY advocating operative interference for syringomyelia, Frazier,[11] in 1930, stimulated renewed interest in the therapeutic possibilities of this distressing condition. This was followed in 1931 by the work of Putnam and Munro[35] who added a series of four cases of syringomyelia treated by myelotomy, together with an excellent review of the subject as developed by the pioneer workers in this field, notably Poussepp and his associates.

That syringomyelia was amenable to surgical interference had been suspected even before Poussepp's initial report in 1926. The classic monograph by Guy Hinsdale,[3] which received the Alvarenga Prize of the College of Physicians of Philadelphia for the year 1895, contained a bibliography of 514 references with only one article indicating a possible therapeutic approach from the standpoint of surgery. This reference was a case report by Abbe and Coley[1] in which a patient with syringomyelia was operated upon, laminectomy performed, and a suspected cyst evacuated, with improvement in the patient's clinical condition. This report has been largely overlooked and sufficient credit has never been given to these early workers who, indeed, displayed extreme courage at a time when spinal cord surgery was still in its infancy. No further surgical treatment for syringomyelia is to be found in the literature until 1916, when Elsberg[8] operated upon a suspected spinal cord tumor and evacuated a syringomyelic cavity. This case is one of the interesting reports in the latter's monumental work on spinal cord tumors and no doubt stimulated further interest in this subject. Hassin[18] and Collier[3] both mentioned cases with operative interference in 1920 and 1921, but little note was made of the outcome of these cases. Individual cases were operated on by Sharpe[41] in 1917 and by Christophe[2] in 1922, but their observations were not recorded until after 1926.

At a meeting of the International Neurological Congress in Paris in 1926, the first report of Poussepp[36] was received with great interest. He gave in detail the results of operation in two cases of syringomyelia. The cervical spinal cord in each instance was incised, the cystic cavity revealed, and fluid released under pressure. Progressive clinical improvement followed and continued for some time. Several additional cases were discussed fully in a later publication by the same author.[37] Within six years after Poussepp's reports, the literature contained some fifty cases of syringomyelia with operative interference, which were carefully compiled and analyzed in 1932 by Schaeffer.[39] This review showed relative improvement in all the cases surgically treated, with only six cases definitely aggravated by interference. The studies tabulated by Schaeffer indicate the interest shown in the continental clinics, only some thirty cases being found in the American literature to date.

The entire subject of the surgical treatment of syringomyelia was very ably reviewed in 1931 by Ssoson-Jaroschewitsch.[42] He distinguished, perhaps for the first time, between the "dry" form with an extremely poor prognosis, and the "hydropic" or "wet" form with increased pressure and subarachnoid block, in which there was a comparatively good prognosis. This care-

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ful differentiation provides one of the necessary criteria upon which to base surgical intervention, since in the majority of cases treated, the maximum of benefit derived has been seen in those with large cystic cavities under increased pressure. The majority of these so-called "hydropic" cases have revealed either a partial or fairly complete subarachnoid block.

Peiper[33] during the same year reviewed the results of sixteen authors with a total of forty-four operations. Five cases showed remarkable improvement, with good results in twenty-one. Additional reports on this subject have been made by Sicard,[43] Vitek,[44] Zeno and Cames,[45] Oppel,[31] Foerster,[9] Peiper,[32] Schmieden,[40] Guleke,[16] Lafora,[24] Kappis,[22] Juzelewski,[21] Cooper,[3] and more recently by Gorsky,[14] Ellmer,[7] and Kuttner.[23] Six deaths have been reported by these investigators, but the majority of the individual reports are favorable, and the wide experience of Juzelewski[21] includes fifteen cases benefited by operation. Davis[5] and Mixter[26] have recently mentioned their experiences with surgical intervention in cases of syringomyelia, and though some of their patients have been able to return to their work, both of these observers are quite conservative in their estimate of the value of interference, and have not reported their cases in great detail.

The latest and most complete review of the subject has been made by Ley,[25] who has carefully analyzed some eighty-eight cases found in the literature and has added four cases of his own. This study includes the post-operative results known in seventy-eight cases. The immediate results were 68.9 per cent improved, 12.9 per cent unimproved, and 18.2 per cent definitely aggravated by operative interference. These figures compare favorably with those of Delherm and Morel-Kahn,[33] who in a summary of ninety-one cases of syringomyelia treated by deep *x*-ray therapy alone, found 70 per cent of the cases improved. However, as Schaeffer[39] has observed, many cases have been little influenced by *x*-ray, and Christophe[2] has found some even aggravated by this type of treatment, possibly due to the edema produced by irradiation.

Clinical improvement following surgical intervention has generally been noted by return of sensation, particularly in the upper extremities, improvement in the trophic disturbances, relief of pain, and a marked decrease in the amount of spasticity. No patient has been cured by intervention, but the majority have been improved and in some cases have been able to return to their former occupations.

REPORT OF CASES

Case 1. F. C., a white female 36 years of age, was admitted to the surgical service of the Hollywood Hospital on March 10, 1933 for observation. The patient had been a dancer in her earlier years and very successful in her profession.

In December 1920, she became conscious of a gradual and progressive weakness of the right arm and hand. She made the rounds of the several neurologic clinics where many and varied diagnoses were made, including tumor of the spinal cord and syringomyelia. In July 1925, the patient entered the Neurological Institute of New York where she was carefully examined. The objective findings at that time included marked weakness of the right hand and arm, some atrophy of both sternomastoid muscles, considerable curvature of the spine in the upper thoracic region, and greatly exaggerated reflexes. A study of the spinal fluid hydrodynamics revealed a clear fluid under low pressure; the impression was that of a partial cerebrospinal fluid block. The diagnosis of syringomyelia was made and the patient was given repeated courses of deep Roentgen ray therapy. She did fairly well for a considerable period of time, but early in 1933 there was noticed a rapid and progressive weakness of the right leg, accompanied by a peculiar sensation of numbness in the fingers of the right hand; in fact, the patient had several times picked up a hot curling iron and was surprised that she suffered a burn without feeling it.

Neurologic Examination. There was marked atrophy of the entire musculature, and the patient weighed 110 pounds. The right hand and arm were rigid and contractured, and the gait was of the right hemiplegic type. Right

ankle clonus and Babinski sign were present, as were bilateral Gordon and Oppenheim signs. The abdominal reflexes were not elicited. Sensation to pin-prick was excellent, but position sense was markedly impaired, particularly on the right side. There was marked disassociation of pain and temperature, the patient being unable to differentiate hot or cold on the right side of the body with the exception of the face. Pain in the right arm and hand was quite severe. (Fig. 1.)

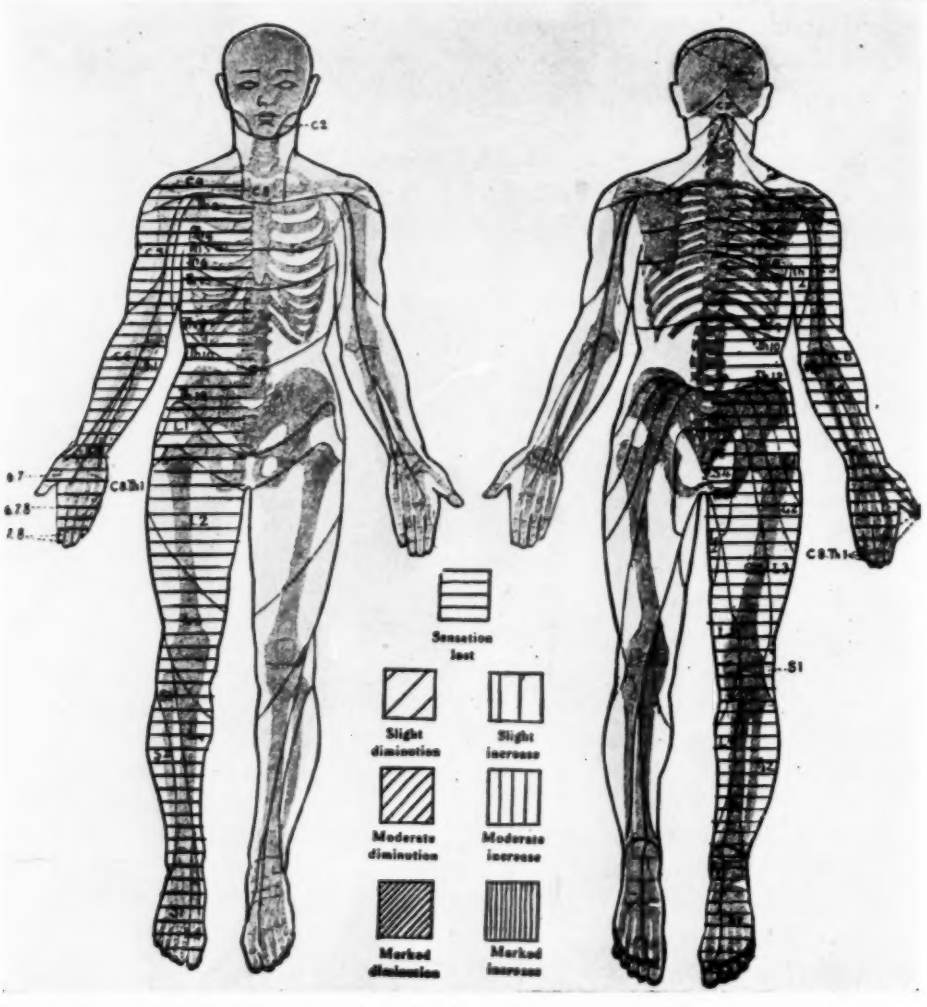

Fig. 1. Case 1. Marked disassociation of pain and temperature—loss of sensation of hot and cold on right side of body.

Laboratory Findings. The regular blood and urine examinations were normal, and the blood and spinal fluid Wassermann reactions were negative. A study of the spinal fluid hydrodynamics revealed a marked subarachnoid block with an increased protein content and two cells.

Diagnosis. Syringomyelia of the cervical spinal cord with subarachnoid block. Since no relief was afforded by intensive deep Roentgen ray therapy, operation was advised.

Operation. Under ethylene anesthesia an incision was made over the spinous processes of the fifth cervical to the first dorsal vertebrae and laminectomy carried out, removing the laminae widely on both sides. The dura was found to be under some increased tension and covered by an extremely small amount of extradural fat. The spinal canal, as such, was greatly widened, perhaps one and one-half times the normal size. The dura was opened by a longitudinal incision revealing a markedly distended spinal cord covered by an extremely adherent arachnoid. Upon gentle palpation the cord at the level of the fifth cervical vertebra

had a distinctly cystic feel, and upon wide reflect of the dura, a large cyst was discovered, having a surface extension on the right side

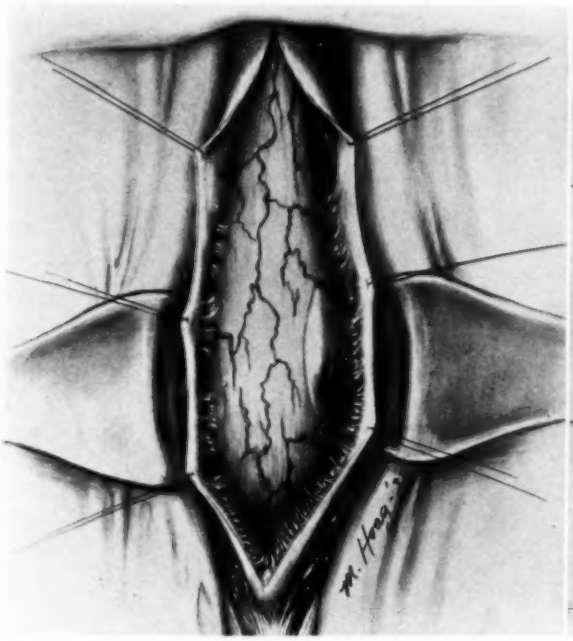

Fig. 2. Case 1. Cervical spinal cord showing cystic enlargement with surface extension.

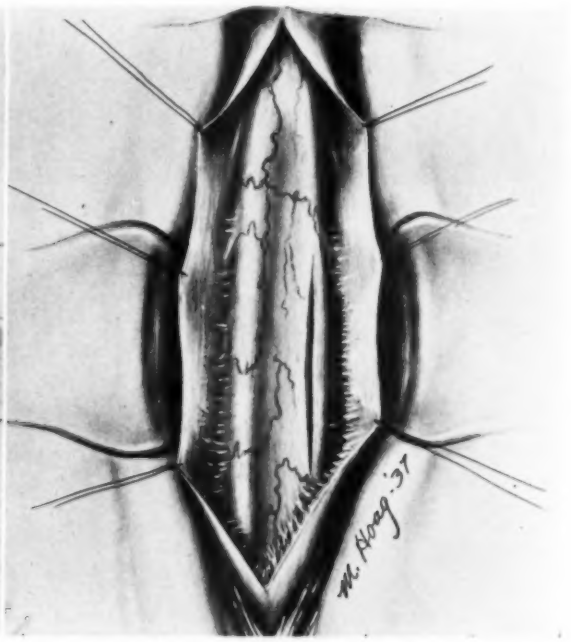

Fig. 3. Case 1. Cervical spinal cord following drainage of cystic cavity.

of the cord. (Fig. 2.) A hypodermic needle attached to a small syringe was introduced into the cystic cavity, evacuating at once a large amount of clear, colorless fluid, approximately 20 c.c. of which was removed by a gentle aspiration. The spinal cord immediately began to shrink in size; after the withdrawal of the fluid, the cord had the appearance of a deflated balloon. (Fig. 3.) A large number of arachnoid adhesions was found; these were attributed to the intensive *x*-ray treatment previously given. The spinal cord was gently split throughout the length of the cystic cavity. The dura was then very loosely closed with three silk sutures, and the wound was closed in the usual manner with black silk.

The post-operative period was most uneventful. The patient felt very comfortable following the operation and was discharged from the hospital within two weeks with increased strength in the right upper extremity. Pain was practically absent and the fingers of the right hand could be moved with considerable freedom.

The patient has been examined every few months since the time of her operation until the present date, and there has been no definite progression of symptoms in her case. She is able, at this time, to continue with many of the duties of a housewife. Pain in the right upper extremity is absent, and the fingers of the right hand have recovered a considerable amount of strength. The gait is still of a hemiplegic type and the right forearm and shoulder are still quite rigid and spastic. There is a fairly definite right Babinski sign and ankle clonus. The sphincters have never been involved. It is felt that operative interference in this case has been of some benefit and, while it is still too early to become enthusiastic about the future of this patient, she will be carefully observed for any new developments.

Comment. This case represents an interesting study in retrospect, particularly in the light of recent observations made on secondarily operated cases. The problem in this case was greatly simplified since the intramedullary cyst had a definite surface extension, eliminating at once, a more or less blind puncture of the central canal as advocated by Poussepp. It was definitely recognized at the operation that the lips of the incision into this cystic cavity would probably be sealed over in the process of wound-healing. The twice

operated cases, notably those of Frazier,[10] Poussepp[37] and Ssoson-Jaroschewitsch,[42] have all shown a closure of the original Mucenicks;[28] Ellmer,[7] Poussepp,[37] and Schaeffer[39] have used muscle for the same purpose; Gardner[13] has used silver clips

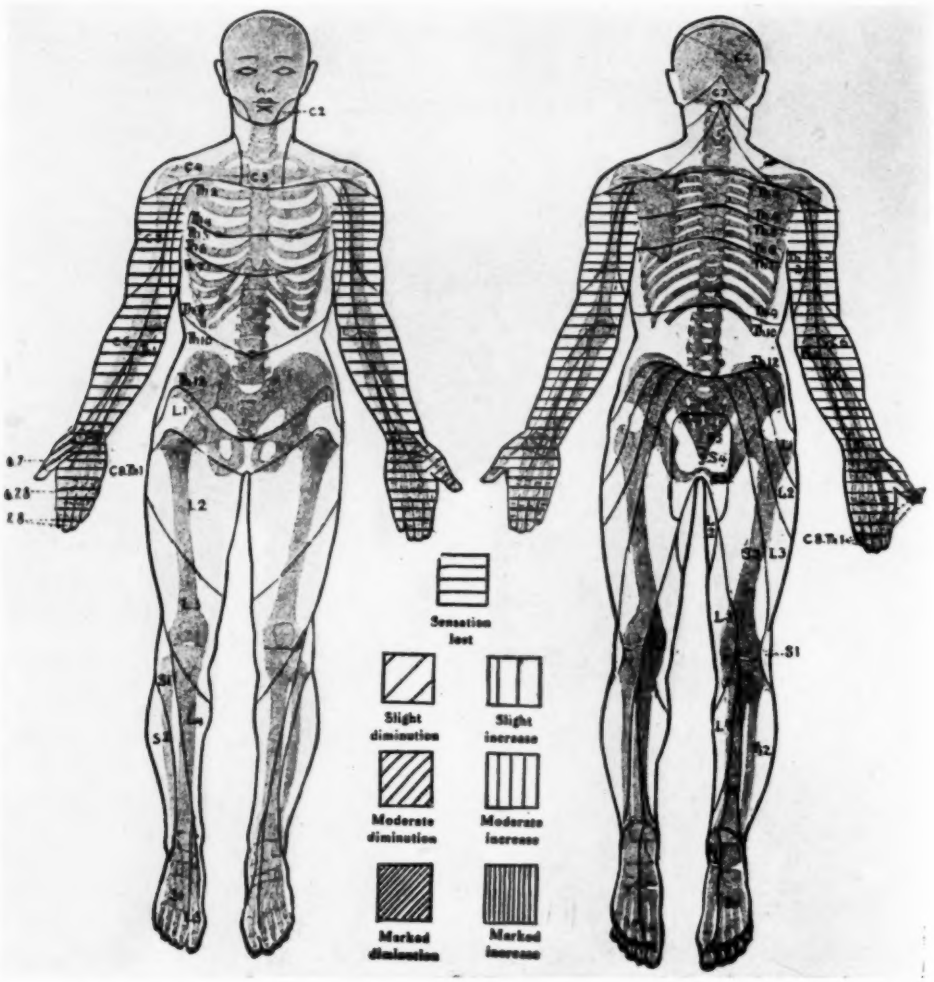

Fig. 4. Case 11. Loss of sensation of hot and cold before operation. Pin prick about equally affected below the elbows.

opening in the spinal cord with a plastic arachnoiditis. In Frazier's case, he attempted at the first operation to insert a thin slip of gutta-percha between the lips of the incision in the cord. Exploration some three years later disclosed the incision healed and closed over, and the gutta-percha drain at the bottom of the cystic cavity. At this session Frazier secured the strip of gutta-percha by clamping it to the ridge of the cordotomy wound with a silver clip. Others, with the object of assuring thorough drainage, have used a small piece of dura inserted in the incision, such as about the lips of the incision, and Mixter,[26] in two cases, has sutured the lining membrane of the cavity to the arachnoid of each side. The dura no doubt is best left open to secure as much decompression as possible.

That simple laminectomy in itself may prove to be of value in relieving the symptoms of syringomyelia has been demonstrated by Guillain, Schmite and Bertrand.[17] Exploratory puncture of the spinal cord carries considerable risk in cases where the suspected cystic cavity is quite small or not under increased pressure. Our

second case of syringomyelia with surgical intervention disclosed a so-called "dry" type which was treated by nothing more

ness of both grips. He had been examined in the Out-Patient Clinic some three times before admission to the hospital and a tentative diag-

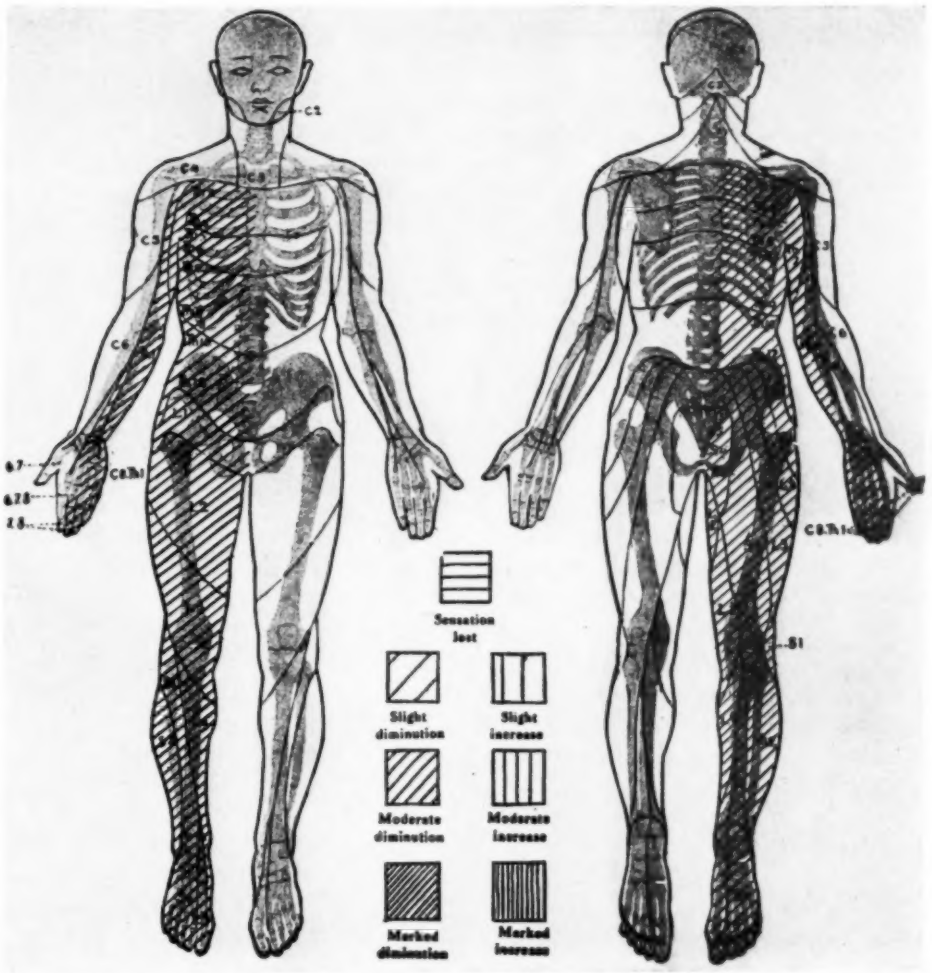

Fig. 5. Case III. Loss of sensation of hot and cold. Pin prick equally affected over the same area.

than a generous laminectomy, following the suggestion of the above authors, with rather interesting results to date.

Case II. C. H., a white male laborer 36 years of age, was admitted to the Medical Service of the Los Angeles County General Hospital on September 26, 1933. He had considered himself well until January 15, 1933, at which time he caught a severe cold while at work. Shortly after recovering from this infection, he noticed that the lower extremities were very cold and that there were progressive sensory changes, beginning with tingling in the right hand. There was also pain in the right upper extremity with progressive marked weakness of both grips. He had been examined in the Out-Patient Clinic some three times before admission to the hospital and a tentative diagnosis of syringomyelia was made. During the two months previous to the hospital admission, the palms of both hands had become so anesthetic that several burns were sustained of which the patient was unaware.

Past History. The patient had suffered many illnesses during his life, having had severe attacks of measles, yellow fever, malaria, typhoid fever, mumps, bronchopneumonia, and left otitis media, in each instance making an uneventful recovery.

Neurologic Examination. This revealed marked weakness of both hands with extreme atrophy. The grips in both hands were nil. The reflexes were markedly exaggerated and increased on the right side. There was an incon-

stant right Babinski sign. The palms of both hands showed a marked anesthesia, except for the thumbs, which were distinctly less affected. The patient was unable to differentiate hot or cold in either upper extremity. There appeared to be areas of hyperesthesia to pin prick about both elbows but not following any particular nerve distribution. Position sense in the right foot was practically lost. Pain in both shoulder girdles was rather constant and severe. (Fig. 4.)

Laboratory Findings. The blood and urine examinations were normal. A careful study of the spinal fluid hydrodynamics revealed a clear fluid with a pressure of 150 mm., and with no evidence of any subarachnoid block. The blood and spinal fluid Wassermann tests were negative.

Diagnosis. A diagnosis of syringomyelia of the cervical spinal cord was made and operation was recommended on account of the apparently rapid progress of the disease.

Operation. Under ether anesthesia an incision was made from the foramen magnum to the sixth cervical spinous process and laminectomy carried out, removing the laminae widely on both sides. There was no extradural fat and the bony tissues were particularly thin. The dura appeared to be under some slight increased tension, and upon opening the membrane, there were found multiple firm web-like arachnoid adhesions. The surface of the spinal cord appeared to be somewhat reddened and the vessels engorged. The extensive arachnoiditis appeared to be generalized throughout the entire length of the exposed spinal cord. The cord itself appeared to be somewhat smaller than what one would normally expect in this neighborhood and careful inspection did not reveal any cyst-like enlargements. It was not thought favorable to attempt to needle the central canal in an effort to locate a possible syringomyelic cavity. The dura was left open and the rest of the wound carefully closed in layers with black silk.

The post-operative period was quite satisfactory. There was almost complete relief of pain in the arms, and muscular strength in the hands began to return at a rapid rate. The patient was discharged to the Out-Patient Clinic for further observation, with the recommendation that he receive deep *x*-ray therapy to the cervical spinal cord should there be any recurrence of symptoms. He was observed for a number of months in the Out-Patient Clinic and exhibited a remarkable return of muscular ability with particular reference to both grips. Pain entirely disappeared. After a year and a half of observation the patient failed to return to the hospital. This case has been more or less lost sight of since, but the end result at the time of this patient's disappearance was considered to be fairly satisfactory.

Our third case was treated in a similar fashion, that is, by simple laminectomy and generous decompression. While the post-operative result was remarkable for its immediate relief of symptoms and increase in muscular strength, there followed after a short six month period of remission a sharp recurrence of symptoms which to date have been only fairly well controlled with deep *x*-ray therapy.

Case III. M. C., a white 38 year old housewife, was first seen on June 18, 1934, complaining of progressive muscular weakness of the left arm and leg with sensory disturbances in the right lower extremity. She stated that her present illness dated back about four and one-half years, at which time both hands became very weak. At this time she had a number of chiropractic adjustments. Following one of these treatments, she stated she was unable to use her arms or legs for a few minutes. In November 1932, the left ankle began to get weak and she dragged the left foot. At about the same time she complained of pain in the left shoulder and arm, with numbness of this extremity. During April 1933, the right leg began to feel numb, and in September 1933, she burned the right ankle with an electric pad and did not feel the pain, although a second degree burn was sustained. By June 1934, there was marked weakness of the left arm and leg with distinct loss of sensation in the right lower extremity.

Neurologic Examination. There was a definite left Horner's syndrome; also, marked weakness of the left arm and leg; left grip practically nil; left hemiplegic type of gait; no definite atrophy of the intrinsic muscles of the hand, forearm or arm on either side. A fairly typical Brown-Séquard type of disturbance was present, there being diminution of touch, pain and temperature on the right side up to about the first dorsal segment, with marked disassociation of pain and temperature senses on the right side. (Fig. 5.) There were several scars of healed burns on the right leg.

A bilateral Babinski sign, marked exaggeration of the knee jerks, absence of Gordon, Oppenheim or ankle clonus on either side, and positive Hoffman sign both right and left, completed the picture.

Laboratory Findings. Urine and blood examinations were normal. Blood and spinal fluid Wassermann reactions were negative. A careful study of the spinal fluid revealed a clear, colorless fluid with one cell and an initial pressure of 90 mm. of water. On bilateral compression of the jugular veins, the fluid slowly rose to 190 and then slowly dropped back to normal. This was interpreted as an incomplete block.

Diagnosis. Syringomyelia of the cervical spinal cord, with incomplete subarachnoid block was diagnosed. Operation was advised, since the patient was rapidly becoming very weak and the sensory disturbances were aggravated.

Operation. Under ethylene ether anesthesia, an incision was made from the atlas to the seventh cervical spinous process and laminectomy carried out in the usual manner. The bony structures were found to be very thin and friable and the spinal canal appeared to be greatly widened throughout the entire cervical area. The dura was under some increased tension and was opened with a longitudinal incision, revealing a grayish and thickened arachnoid with many fine adhesions. The posterior surface of the spinal cord was covered with greatly enlarged and tortuous vessels. No cyst-like appearance of the cord was discovered and it was not thought wise to attempt to explore the central canal in a blind effort to locate a possible cavity. The dura was left open and the wound closed in layers with black silk.

The post-operative course was highly satisfactory. The patient was discharged to her home on the fourteenth post-operative day, at which time there was increased strength in the left arm and leg. She remained quietly at home for the following month, during which time she found herself able to get about the house without aid, and at the end of two months was quite able to do some of the housework—something which she had not been able to do for the previous year. The tendency to a hemiplegic gait on the left side almost completely disappeared and there was a considerable improvement in sensation in the right lower extremity. Some three and a half months following operation the patient stated that she thought her general condition to be excellent. She had gained some 15 pounds in weight, and was able to perform most of her work as a housewife. This improvement continued for almost six months following operative interference, when suddenly the patient noted that the left leg again began to drag and there was some pain in the right arm and leg. She also found that she was becoming markedly constipated and at times would have difficulty in controlling the bladder, resulting in incontinence or dribbling. Since there appeared to be a definite recurrence of the former trouble, the patient was subjected to deep *x*-ray therapy over the spinal cord in the cervical region with some improvement to date. She has received several courses of deep therapy and will be carefully observed for the effects of this treatment. While she was definitely benefited by laminectomy and decompression, it is our opinion that the early recurrence of symptoms speaks for an increased gliosis about the central canal which may respond to deep *x*-ray therapy.

A recent paper from Frazier's[12] clinic has encouraged secondary intervention in cases failing to improve or with subsequent relapse following surgery. This view is also held by Oppel and Mucenicks and in the light of their experiences appears to be fully justified. In Frazier's first case, there was a second operation some three years after the initial interference, with enough improvement to indicate the value of repeated drainage in certain selected instances.

DIAGNOSIS OF SYRINGOMYELIA

The familiar picture of the disassociation syndrome (Charcot), loss of pain and temperature sensibility with atrophy of the extremities, is too well known to require detailed description at this time. The literature concerning this interesting disease is voluminous and dates back almost 200 years since Margagni and Santorini[27] first observed and recorded the existence of an abnormal cavity in the spinal cord. Portal,[34] in 1800, and Rachetti,[38] in 1816, also noted this strange phenomenon which had excited the curiosity of anatomists in the seventeenth and eighteenth centuries.

The pathologic condition passed without a distinctive name until, in 1837, Ollivier[30] called the affection "syringomyelia," a name by which it has since been generally designated. Virchow then looked upon all cavities in the spinal cord as expansions of the normal central canal and termed the condition "hydromyelia." To date no etiologic factor in this disease has been definitely described, although a congenital basis has long been considered the immediate cause.

A careful study of the spinal fluid hydrodynamics has never been greatly stressed with the exception of such recent authors as Putnam and Ssoson-Jaroschewitsch. In several of the cases described by various authors, evidence of cerebrospinal fluid stasis has been discussed. The fluid itself may reveal nothing more than some slight increase in cells and protein content even with a well advanced spinal fluid block, and since this constitutes many times the direct indication for intervention, careful pressure studies should always be made. Ssoson-Jaroschewitsch has divided his cases into so-called "dry" and "wet" or "hydropic" types based mainly upon the appearance or absence of a subarachnoid block. He believes that the so-called "dry" form with no evidence of fluid stasis carries an extremely poor prognosis and should not be operated upon. This constitutes one of the most important indications for intervention since many cases showing improvement after surgery have been of the "wet" or "hydropic" type with either partial or a fairly complete subarachnoid block. The use of iodized oil for localization has been suggested by several investigators and has been carried out by Jirasek.[20]

SURGICAL CONSIDERATIONS

The nature of this disease makes every step in the handling of a given case a hazardous procedure. These patients, as a class, take inhalation anesthesia badly and no doubt are best treated with local anesthesia. In those patients who are given a general anesthetic, the intratracheal technique, as practiced by Guedel[15] and his associates, has proved very satisfactory in our hands and has caused no untoward complications.

The operation, after a generous laminectomy has been performed, consists in puncturing the suspected cavity site in the spinal cord in the midline (Poussepp) or an incision similarly in the midline (Putnam) or an incision a few millimeters lateral to the midline on the side of the greatest cord damage (Frazier). After the cavity has been opened, permanent drainage may be established by the use of dura (Mucenicks), silver clips (Gardner), muscle (Schaeffer), or suturing the lining membrane of the cavity to the arachnoid of each side (Mixter). The wound, if closed carefully with black silk throughout, tends to heal kindly. However, precautions should be taken to see that the edges of the wound are tightly secured with adhesive strapping and that the patient is not allowed to pull himself up or to either side for a matter of several weeks; otherwise, the wound edges may break open with danger of secondary infection. Since the operative site many times is located within an anesthetic zone, it is easy to see how such a wound might fail to heal properly.

EVALUATION OF SURGICAL RESULTS

It has been very difficult after reviewing the results of surgical intervention in approximately 120 cases, to gain a true perspective of the value of surgical therapy. As Frazier[12] has observed, there have not been enough available reports to indicate the late results of surgery, that is, of cases which have been observed for at least one year following operation. He was able to collect only some sixteen cases followed for a year or more after intervention. A review of Ley's work—(Table 1) indicates the paucity of properly observed cases. Nevertheless, the same criticism holds true for those cases which have been treated by deep *x*-ray therapy alone. The observation of Mixter[31] is probably correct, that in all cases of syringomyelia, improvement under

Roentgen ray therapy or by surgery is difficult to measure because any improvement gained is frequently temporary. erroneus impression from the reported cases may be obtained since it is very likely true that an equal number of failures

TABLE I

REPORTED CASES OF SYRINGOMYELIA WITH SURGICAL INTERVENTION

	Number of Cases	Worse	Not Improved	Improved	Much Improved	Time of Observation
Elsberg	3	..	..	3	..	over 6 months
Poussepp	7	1	..	6	..	2 to 7 years
Sicard	3	2	..	1	..	over 6 months
Van Gehuchten	1	1	..	..	..	4 years
Jirasek & Vitek	4	..	..	4	..	over 6 months
Zeno & Cames	1	..	..	1	..	over 6 months
Oppel	6	1	1	3	1	over 6 months
Foerster	1	..	..	..	1	2 years
Schmieden-Peiper	4	..	3	..	1	4 months to 2 years
Guleke	1	..	..	1	..	over 6 months
Lafora	1	..	1	..	..	4 months
Kappis	1	..	..	1	..	over 6 months
Juzelewski	15	..	..	15	..	over 6 months
Heymann	1	..	..	1	..	5 years
Cooper	1	..	1	..	..	over 6 months
Frazier	2	..	..	2	..	1 case 4½ years 1 case 2 years
Putnam & Munro	4	1	1	2	..	1 case 1½ years
Girgolaw & Ssoson-Jaroschewitsch	2	1	..	1	..	1 case 1 yr. 4 months
Gorslij	1	..	..	1	..	over 6 months
Ssoson-Jaroschewitsch	4	..	..	4	..	over 6 months
Ellmer	1	..	..	1	..	1 year
Korcic	2	..	1	1	..	over 6 months
Moniz, Pinto & Lima	1	1	..	..	..	1 month
Diaz Gomez	2	..	1	1	..	over 6 months
Kuttner	1	..	..	1	..	over 6 months
Biolato	1	..	..	1	..	over 6 months
Mucenicks	2	..	..	2	..	over 1 year
Mixter	18	1	..	..	..	series collected since 1919 statistics not given
Bassoe	1	..	..	1	..	over 6 months
Gans & Suermondt	1	..	..	1	..	over 6 months
Gardner	2	..	1	1	..	over 6 months
Zeitlin (Quoted by Putnam & Munro)	6					
Sharpe	1	..	..	1	..	5 years
Hassin	1	..	..	1	..	over 6 months
Collier	3	1	..	2	..	over 6 months
Christophe	1	1	..	..	..	lived one month
Ley	4					
Davis	6	Statistics not given				
Adelstein	3	..	..	3	..	1 case 4 years 1 case 1½ years 1 case 2½ years
Total cases	120					

Many patients, however, though greatly handicapped, have been able to return to their work. Davis[5] has indicated that an have not been published. Also, it is difficult to know whether improvement may last and whether or not in any particular

patient, the progress of the disease has been so slow that the operation has played no important rôle.

It is Davis' recommendation[5] that perhaps combined radiation therapy and myelotomy may prove to be the method of choice.

The various analyses made by Ley, Frazier, and others indicate that approximately 50 per cent or less of patients who have been treated by surgical intervention have been able to return to a useful occupation and remain employed for a substantial period of time. Frazier has felt that this improvement more than compensates for the possible failures and dangers of operation.

COMPARISON WITH X-RAY THERAPY

The treatment of syringomyelia for many years has been deep *x*-ray therapy, which in many cases has achieved an improvement of both motor and sensory disturbances. Delherm and Morel-Kahn[6] reviewed a large number of cases, with improvement in over 70 per cent. Their personal results were not quite so good and about one-third of the cases were aggravated by treatment. O'Brien,[39] in reporting thirty cases treated by irradiation only at the Boston City Hospital, found definite improvement in 75 per cent of the patients. The nature of improvement consisted in a cessation of pain, healing of trophic ulcers, return of thermal sensation, restoration of normal speech and deglutition, and in some instances ability to return to a gainful occupation. O'Brien believes that his later cases have shown more immediate improvement since the technique of Coutard has been employed, namely, protracted high tension, low intensity irradiation. Improvement occurred in so many cases and so promptly that he feels it is unreasonable to suspect that it was due to spontaneous remission or to the natural history of the disease. As Putnam has suggested: "It is natural to suppose that irradiation acts on the glial lining of the cavity or its blood vessels rather than upon its fluid contents. Indeed it would not be surprising if the pressure within the cavity were actually increased by the breakdown of the cells in its walls. Thus operation and radiation should theoretically supplement each other." This seems to offer the best explanation for the results of combined therapy.

SUMMARY AND CONCLUSIONS

1. Three cases of syringomyelia are described in detail showing improvement over periods of one and one-half, two and one-half, and four years respectively, following surgical intervention. The interference employed was laminectomy and drainage of the syringomyelic cavity in one instance and generous decompression in two cases.

2. A review of the available cases from other clinics has been attempted. A conservative estimate of the ability of patients who have been able to return to a useful occupation would indicate that less than 50 per cent were sufficiently improved after operation to return to their vocations.

3. The indications for surgery must depend, in addition to the clinical picture, upon a careful study of the spinal fluid hydrodynamics with intervention limited to those cases revealing a partial or complete subarachnoid block.

4. The surgical technique practiced by the majority of surgeons who have treated these cases includes:

   A. The use of local anesthesia.
   B. An incision in the posterior surface of the spinal cord either in the midline or on the side of greatest clinical damage as so aptly described by Frazier.
   C. An attempt at permanent drainage by the use of drainage material, such as silver clips, muscle, dura, etc.
   D. Secondary operation in certain selected cases appears to be justified where the clinical condition is not improved or where there is a relapse following initial drainage.

E. Where the syringomyelic cavity is difficult to locate, laminectomy with decompression afforded by opening of the dura appears to be worthy of trial.

5. In agreement with Davis, Mixter and Putnam, it appears that the logical treatment of this disease is surgical intervention supplemented with irradiation, since *x*-ray probably exerts its influence solely on the gliosis while the cavitation may be adequately treated only by surgical drainage.

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COMMON DUCT OBSTRUCTION

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OBSTRUCTION of the common duct is at all times a grave surgical condition, and although some of the causes, such as common duct stones, or pressure from without, are completely removable by surgery, most of them, unfortunately, including intrinsic obstruction involving the wall of the duct, stricture and malignancy, cannot be completely relieved. In addition to the mechanical difficulties presented by this problem, one is further handicapped by the unexplainable reactions of patients to this type of surgery. In late years we seem to some extent to be able to evaluate the dangers and the resistance of the patient, but our prognosis is by no means so accurate as in operations upon the pelvic organs. Such undetermined factors undoubtedly are concerned with physiologic chemistry, the sympathetic nervous system, and acute and chronic infections. A great deal remains to be learned before we will be able to approach biliary surgery with the same confidence as we do that of other intra-abdominal organs.

ETIOLOGY

The causes of common duct obstruction are either congenital or acquired. While congenital defects are rather rare, some feel that icterus neonatorum, in a certain number of cases at least, is due to stricture, tumor or more frequently stone, in the common duct of the infant.

The acquired causes may be grouped under the following three subdivisions:

A. Conditions Compressing the Duct from Without:

1. Primary or secondary tumors of the head of the pancreas.
2. Enlarged glands from such conditions as malignancy, syphilis, tuberculosis, and Hodgkin's disease.
3. Aneurysm of the hepatic artery due to syphilis, tuberculosis, embolism, nearby suppuration, or injury.
4. Malignancy of neighboring organs.
5. Peritoneal adhesions.

B. Conditions Affecting the Duct Wall: The only condition of importance here is stricture, which occasionally is of congenital origin, but is usually due to inflammation, ulceration and scar tissue formation, the result of stone in the duct or surgery of the duct. Prolonged T-tube drainage is a frequent cause of stricture.

C. Conditions within the Duct Causing Obstruction:

1. Parasites, such as roundworms.
2. Catarrhal or suppurative cholangitis.
3. Tumors, of which carcinoma, papilloma and adenoma are the outstanding examples.
4. Stone.

The most important cause of common duct obstruction is stone in the duct. While stones may form primarily in the ducts, they have usually originated in the gall-bladder and later have passed into the ducts; this latter condition obtains in about 20 per cent of gall-bladder stone cases. Infection caused by any bacteria, but particularly the Streptococcus viridans, and typhoid, and colon bacilli, reaches the biliary tree by way of the lymphatics, the bile, or the blood. It supplies the organic nucleus upon which, through stasis, precipitation of cholesterol and other salts, stone formation is completed.

A history of typhoid, pregnancy, or appendiceal disease is noted in many biliary stone patients, and occasionally there is a history or evidence of peptic ulcer or nose and throat affections. Sedentary habits, general atony, obstruction to drainage, interference with innervation, over-eating, and lack of exercise increase

the incidence of cholelithiasis. Fat women past the age of forty, who are of the blonde type, suffer more frequently than others (the famous Fair, Fat and Forty triology).

PATHOLOGY

The bodily damage from common duct obstruction depends upon the completeness and rapidity of the obstruction, as well as upon the presence or absence of preexisting inflammation and the etiologic factor. Courvoisier, nearly one hundred years ago, stated that in jaundice due to pressure on the common duct from without, the gall-bladder dilates, while with impacted stones in the duct, the gall-bladder is usually small. While this holds true in 90 per cent of cases, it is unreliable in about 10 per cent.

In any case of obstruction of the common duct the following pathology is present in greater or less degree:

Hydrobepatosis. There is a dilatation of the biliary tree above the obstruction, which extends even into the small liver ducts. It is greater as a rule in obstruction due to a cause other than stone: (1) because stone cases are usually accompanied by diseased and fibrosed ducts and gall-bladders which dilate less readily; and (2) because the cases of obstruction from pressure on the ducts usually do not have infection and fibrosis, are of shorter duration, and have more complete obstruction. The gall-bladder is contracted in 80 per cent of common duct stone cases.

White Bile Formation. When the pressure in the bile ducts increases enough, the bile stops forming and that in the biliary tree is absorbed. The mucous glands, however, continue to secrete, and thereby the so-called "white bile" is formed. This is greater in stone cases.

Obstructive Jaundice. Bilirubin, since it is formed from blood pigment by the reticuloendothelial system of the body and excreted by the polygnal cells of the liver, cannot enter the duodenum in obstruction of the common duct, and is therefore absorbed. Thus jaundice is produced, which affects the entire body, particularly the convoluted tubules of the kidney.

Any loss of weight is dependent upon pain and loss of sleep, combined with infection and the commonly seen restriction of diet. Charcot's fever always means infection of the ducts—a cholangitis.

Three different types of stone may cause common duct obstruction:

1. *The Septic or Infected Type.* This is the type usually present. It is concentrically laminated, often faceted and multiple, and upon examination proves to be composed of cholesterol and calcium bilirubinate. Stones of this variety often occur in families.

2. *The Metabolic Type.* These are usually single, of a white color and radiate structure. They are made up principally of cholesterol.

3. *The Pigment Type.* This stone is seen in hemolytic jaundice. It is small, rice-like in size and presents a hard, black, brittle appearance. These stones are practically always multiple and contain no cholesterol.

SYMPTOMS AND SIGNS

Since there are so many causes of common duct obstruction, the symptoms and signs will naturally vary and depend upon the causative lesion, neighborhood affections, and whether or not infection or complications are present. Yet symptoms of the obstruction, per se, occur only when a foreign substance is in transit through the ducts, when infection has occurred, or when deficient drainage has resulted. Regardless of the cause, any common duct obstruction usually causes lowered resistance, with an itching, yellow, or bronze skin and yellow conjunctivae, and often transforms the patient into an irritable person who cannot sleep, who loses weight, and complains of a variety of gastro-intestinal symptoms, such as gas on the stomach, belching, flatulence, fulness after eating, nausea, vomiting and distress after

eating certain foods, especially those of a greasy type. The pylorospasm and other gastrointestinal symptoms result from a reflex through the ninth dorsal segment, which supplies the stomach, pancreas and duodenum as well as the biliary tree.

The previous history in stone cases will often reveal the gastrointestinal group of symptoms to which jaundice and colic are added, but in other than stone cases the past history is often negative, or is only that of the causative lesion.

Pain or colic is usually of stone origin, but spasm of the ducts or the passage of clots, mucus, or fragments of a tumor may give similar, though usually milder pain. Colic is usually of a violent nature and is characterized by its sudden onset a few hours afterwards, variable duration and sudden cessation. The pain may be in the region of the gall-bladder, the epigastrium or the umbilicus, but may be, and frequently is referred to the back, the lower part of the right chest, or the shoulder. It may be of varying intensity, but usually is so severe that the patient is in agony and cannot be still. He rolls or tosses about, or even walks the floor in an effort to try to find a position which will give him some relief.

Jaundice is generally intense. It may be absent or slight in any case of common duct obstruction, but tends to be intense and progressive, without pain or infection in other than stone cases. Patients having stones in the duct have incomplete, milder jaundice, with periodicity in intensity, which may appear twenty-four to forty-eight hours after an attack of colic. Mild jaundice may rarely follow colic from stone that does not leave the gall-bladder.

Fever is not apt to be present unless there is some infection. When Charcot's fever occurs, characterized by chills, sweats, and irregular, intermittent, steeple type temperature curve, one can be sure that a cholangitis has supervened, and especially if the attacks are of short duration and occur with or after the pain and jaundice. Infected bile can cause cholangitis and if the infection extends into the hepatic ducts a continuous fever may follow.

The liver enlarges in most cases of obstruction and, with the enlarged gall-bladder is sometimes palpable.

DIAGNOSIS

The common duct obstruction per se is easily diagnosed when the jaundice is shown by blood, urine, and stool examinations to be of the obstructive type, but the causative lesion may be diagnosed only with difficulty or may be entirely missed. The blood shows an increased icterus index, a positive and usually direct immediate Van den Bergh test, with red blood cell changes of decreased fragility, macrocytosis and an absence of reticulocytes. The serum phosphatase is often increased above normal, the bromsulfalein test is normal unless the liver is damaged, and bile salts are retained in the blood. The stools are clay colored and contain very little or no stercobilin, and on duodenal drainage, bile is absent or scant.

If the liver is not damaged, the urine shows a normal amount of sugar after the galactose test. The urine is dark and contains bile, but shows little or no urobilinogen; if there is complete absence of urobilinogen in a case of jaundice, common duct obstruction is indicated.

Of especial importance is the fact that this type of jaundice is accompanied by itching.

Conditions Compressing the Duct from Without:

1. Carcinoma of the head of the pancreas. There is a jaundice which is persistent and progressive; it usually is intense and of a mahogany hue. It is not accompanied by fever or pain, but there is a palpably enlarged gall-bladder.

2. Adjacent tumors and glands. These are diagnosed only by the signs and symptoms of each condition.

3. Aneurysm. While this is usually missed; it should be thought of in syphilis, endocarditis and injury as well as in tuberculosis and suppuration.

Conditions Affecting the Duct Wall:

1. Congenital affections show persistent jaundice and the infant soon dies. Autopsy reveals the pathology.

2. Scarring, ulceration and stricture of the duct give a history of the presence or passage of a gallstone, or of surgery done on the duct with or without prolonged T-tube drainage.

Conditions within the Duct:

1. Inspissated bile has no distinguishing signs.

2. Parasites. A careful history and stool examination will show parasites in the gastrointestinal tract and the further diagnosis of them, being in the biliary ducts, can only be conjecture. I have removed dead ascarus worms from an abscess about the ducts. Hydatid cysts may cause pressure on the ducts or may cause cholangitis if the contents drain into the ducts.

3. Tumors. Time or surgery is necessary to distinguish most cases of papilloma or cystadenoma from carcinoma of the ducts since all show obstruction which becomes more or less complete, and produces a jaundice which is intense, persistent and progressive, and without pain or fever.

4. Stone. If the stone is in transit, colic is severe and ceases only when the stone is passed or when it becomes "quiet." Jaundice follows within twenty-four to forty-eight hours and tends to clear up more or less between attacks, but fever is absent unless infection occurs, in which case attacks of Charcot's fever tell of cholangitis. The gall-bladder is not palpable as a rule since it is small, but the *x*-ray may show stones in it or even in the ducts. Duodenal drainage is very likely to reveal cholesterol and calcium bilirubinate crystals.

DIFFERENTIAL DIAGNOSIS

1. *Catarrhal jaundice* is generally a disease of the young, lasting two to six weeks, and has no pain but only mild gastrointestinal symptoms. A positive galactose test may be given showing liver damage, and the Van den Bergh test is often indirect but is not to be definitely relied upon.

2. *Hemolytic jaundice* shows anemia with a jaundice of less intensity which is unaccompanied by itching. There are often pigment gallstones in the gall-bladder. Bile salts are not retained in the blood, the icterus index is lower than in obstruction of the duct, and the red blood cells show increased fragility, microcytosis and an increase of reticulocytes. The urine contains an increase of urobilinogen, but no bile, and the stools are normal.

3. *Hepatic Cirrbosis.* A milder icterus combined with ascites, hemorrhages and a low bromsulfalein test point to liver disease.

4. *Malaria* is diagnosed, and distinguished from Charcot's fever, by the leucopenia, and the enlarged spleen in conjunction with periodicity and parasites in the blood.

5. *Sepsis.* The history and other clinical signs in conjunction with a mild jaundice and remittent fever and blood cultures distinguish this condition.

6. *Sypbilitic capsulitis* may give difficulty unless a Kahn is run.

7. *Acute Yellow Atropby.* The history, residence, and hemorrhages, with the black vomit, are distinctive when combined with a small liver functioning poorly. Urea and uric acid are decreased both in the blood and the urine, and leucin and tyrosin are excreted.

8. *Chronic Pancreatitis.* It must be remembered that pancreatitis may follow biliary stone and that the two are hard to differentiate clinically. In the former, the gall-bladder is often enlarged, and there is an impaired digestion of fats and proteins which gives rise to pale, abundant stools covered with a scum of fat and containing unstriated muscle fibers and unsaponified neutral fat. Glycosuria is often present.

9. Urinary and gastric affections as well as tabes may need to be excluded if jaundice is present.

10. Liver affections, such as abscess, cancer, and hydatid cyst, as well as poisons, need exclusion.

PROGNOSIS

The prognosis depends on the cause and accessibility of the lesion, as well as the condition of the entire body, especially the liver and pancreas.

Carcinoma of the pancreas, malignancy of the abdominal viscera with metastasis, Hodgkin's disease and tuberculous glands, are hopeless, as are cases of leucemia, pylephlebitis, and cholangitic abscess.

Syphilis may be cured and chronic pancreatitis is often helped by biliary surgery, but aneurysm and congenital defects are serious. Benign tumors of the ducts should have a better outlook although the operative procedure itself carries a high mortality. Even carcinoma should have a lower mortality since metastasis is relatively late.

Patients with stones in the ducts have a very favorable prognosis if properly handled; the stones of hemolytic jaundice usually disappear after splenectomy and require no biliary surgery. The pancreas is frequently affected by stones in the ampulla of Vater below the duct of Wirsung.

TREATMENT

The treatment is essentially surgical.

Preoperative Management. Pain must always be relieved, and this is done by morphine and atropine in doses large enough to be effective, combined at times with hot enemas, heat applied locally to the abdomen, and even whiffs of ether or chloroform in selected cases. Preoperative measures are vitally necessary and a positive galactose test makes them still more imperative, but if the serum bilirubin does not decrease in a week further delay is not advisable.

The diet requires a reduction in fat and a decided increase in carbohydrates. Orange juice with sugar should be given every few hours for three or four days before operation. Fluids in amounts of 3 to 5 liters daily are necessary. Where vomiting is present, fluids must be given parenterally, preferably by vein or by hypodermoclysis. Where vomiting is excessive, the Wangensteen apparatus is also valuable. Five per cent glucose in normal saline by vein is of especial value. In all cases it is wise to give 50 Gm. of glucose by vein the evening before operation. One or two blood transfusions and 5 c.c. of a 10 per cent solution of calcium chloride daily for three days, in conjunction with parathormone, are very valuable in reducing the danger of hemorrhage.

The medication consists of sodium alurate, gr. 3, the night before and again one hour before the operation, followed by scopolamine, gr. $\frac{1}{200}$, one-half hour before, and morphine, gr. $\frac{1}{4}$, combined with atropine, grain $\frac{1}{150}$, fifteen minutes before the operation.

Operation. The anesthetic of choice is 200 mg. of novocaine crystals dissolved in 2 to 2.5 c.c. of spinal fluid and injected intraspinally. This is followed preferably by the Bevan incision to open the abdomen. From there on the procedure depends on what is found:

A. Pressure on the Duct from Without. (a) Carcinoma of the head of the pancreas. Only palliative measures can be used, such as cholecystostomy or anastomosing the gall-bladder to the stomach, duodenum or jejunum.

(b) Chronic Pancreatitis. If gallstones are present they require proper treatment, but if not, then cholecystostomy or cholecystenterostomy may be used. The best procedure is probably cholecystectomy and drainage of the common duct.

(c) Aneurysm. There is no treatment of this condition itself, but cholecystenterostomy may be done since the abdomen is open.

(d) Glands about the Duct. Some cases warrant an attempt at removal, but in hopeless cases cholecystenterostomy may be done for palliation.

(e) Tumors of other organs are usually not amenable to other than cholecystenterostomy.

B. Conditions in the Wall of the Duct. If stricture should follow passage of a stone, and the gall-bladder is movable and no other stone present, cholecystenterostomy is feasible. A ligated duct demands release. If the stricture follows surgery, adhesions may be dense and the duct not found, in which case anastomosis of the gall-bladder to the stomach, duodenum, or jejunum may be done, or drainage may be used for a time and then the tract anastomosed to the duodenum over a tube fixed by a silk suture. If a stricture is localized, accessible, and annular, it may be cut at right angles and a T-tube inserted for a short time; other cases may have an implantation of the duct above the stricture into the duodenum. Some have tried excision of a localized stricture and then performed an end-to-end anastomosis.

C. Conditions within the Lumen of the Duct. (a) Parasites can be removed surgically and medication given afterward.

(b) Inspissated bile requires drainage of the duct.

(c) Cholangitis requires removal of the cause, such as stones, and drainage of the ducts and gall-bladder.

(d) Stones. If the stone is accessible above the duodenum, the duct should be opened and the stone removed, after which drainage both of the gall-bladder and the common duct is indicated. A cholecystectomy should not be done at this time. When the stones are lower down they may be milked back up above the duodenum in some cases and removed, but if this is not possible then retroduodenal or preferably transduodenal removal is needed—again draining the duct and gall-bladder. When adhesions are dense it may be necessary to locate the duct by passing a probe up through the duodenal papilla.

(e) Tumors of the Ducts. Excision of early malignant and most benign tumors is indicated. If the growth is supraduodenal and below the cystic duct, a preliminary gall-bladder drainage or cholecystenterostomy is wise, the excision being done at a second operation. Lesions of the ampulla or duodenal part of the duct call for a transduodenal excision if possible, after drainage as above. After excision, some have tried an end-to-end anastomosis, or implantation of the duct into the stomach or duodenum.

Postoperative Treatment. Morphine should be given to allay pain and restlessness, but excessive amounts should be avoided because it tends to increase distention. If gaseous distention occurs, it can be handled by gas enema, heat to the abdomen and pitressin if needed. I am a firm believer in keeping peristalsis active because if the peristalsis and bowel movements are maintained, the patient will not die from the distention, even though infection be present. In this connection, it is a good principle to insert the Wangensteen apparatus immediately after operation, as it helps care for and prevent nausea, vomiting and gas. Bile is collected, measured, and should there be dehydration and loss of weight, it can be re-fed to the patient in grapejuice, through a tube or by rectum.

Blood transfusions after operation are valuable, and fluids by vein and hypodermoclysis are needed for a few days in quantities of 3 to 6 liters. Glucose 5 per cent in saline should be given by vein in liter amounts twice or three times daily and the balance of fluid as normal saline given by hypodermocylsis.

The bladder should be watched and catheterization done if necessary, the output of urine should be measured, and the urine examined daily. If stimulation is needed, digitalis is the drug of choice. Feeding by mouth is begun when the patient's condition admits, starting with fluids and slowly increasing up to normal diet by the end of ten days. The drainage tube in the common duct may be clamped at stated intervals, after about ten days, and if bile passes normally through the duct and no symptoms are caused thereby, the tube can be removed.

CASE REPORTS

Case I. Carcinoma of ampulla of Vater.

An Italian male, age 52, gave a history of an indefinite gastric upset in October 1933, after which he was well until December, when he developed a painless jaundice together with fever, vomiting and malaise. He noted that his stools were light and his urine dark. He grew gradually worse and in January 1934, he was admitted to the hospital and placed on biliary drainage and a fat-free diet with little result. His G.I. series was negative and the Van den Bergh test ranged from 2.2 to 18 during his stay in the hospital. March 1, he left the hospital against advice, and returned March 6, decidedly worse. He had also developed a diarrhea and an enlarged gall-bladder. Laparotomy revealed a large gall-bladder with no stones, but palpation of the ampulla region showed a small nodule. The gall-bladder and common duct were both drained. The tube was removed in a week or so and the wound healed.

During May and June, the jaundice nearly cleared and the Van den Bergh dropped to .25. On July 5, however, he developed chills, sweating and fever, followed by intense jaundice, which never disappeared. In July and August, he had four or five attacks which continued at intervals of a few days in September and October. At his last admission on October 12, he complained of the painless jaundice with the Charcot fever, syndrome, itching, and loss of 20 pounds of weight. He was very nervous, slept poorly and felt weak.

On examination he was thin and markedly jaundiced, with evidence of scratch marks on his body. The scar of the recent laparotomy was visible. His liver and gall-bladder were enlarged and his mouth was very dirty.

The Kahn test was negative, the Van den Bergh 15, and the icterus index 95. The urine was dark but contained no urobilinogen.

As conservative treatment gave no benefit, laparotomy was done. The presence of metastasis to the liver caused us to do a cholecystojejunostomy. The Wangensteen was started and glucose and saline were given by vein; blood transfusions were administered, but the Charcot attacks continued, the anastamosis broke down, and the patient died.

Autopsy showed the broken down anastamosis and revealed carcinoma of the ampulla of Vater with metastasis to the liver, together with cholangitic abscesses. A fistula was found between the common duct and the stomach which may have explained the jaundice clearing up in June. Microscopy of the tumor showed it to be adenocarcinoma.

Case II. Stricture of the common duct.

A white female, age 33, was admitted September 6, 1934. She gave a history of having had six attacks of pain in the right upper quadrant and back with vomiting and flatulence since November 1933. Greasy foods had distressed her during this time. She had noted no jaundice or alteration of her stools or urine at any time, but had lost 18 pounds in weight.

She gave no history of typhoid. She had had three children and four miscarriages; a pelvic laparatomy with appendectomy had been performed.

On examination, she appeared thin, but had no jaundice. The gall-bladder area was quite tender. A few piles were present. Otherwise examination was negative.

On September 8, a cholecystectomy was done; many adhesions were found, but the common duct appeared normal. On September 17, pain developed in the right upper quadrant, followed by jaundice, distention of the abdomen with fluid, swelling of the legs and flatulence. The icterus index was 52 and the stools were free of bile. The abdomen was tapped on October 6, when 8000 c.c. of bile-stained fluid was removed, and again on October 10, when 4000 c.c. was removed. Bile was present in the urine, the Van den Bergh was 2.5 and the *x*-ray showed the diaphragm high.

At operation on October 23, no peritonitis was present and the common duct could not be located. No stones were found, and drainage was therefore instituted. In two weeks the bile was tested for sterility and re-fed to the patient in grapejuice. The drainage stopped and the wound healed. It is possible that a fistula may have occurred which allowed the bile to enter the gut.

At a later date a probing of the duct via the duodenal papilla may be necessary, or a drainage tract can be anastomosed to the duodenum over a tube.

Case III. Pylephlebitis with common duct stone.

A 46 year old mulatto was admitted to the medical service October 4, 1934, giving a history of pain in the right upper quadrant, vomiting and jaundice of ten days' duration. In the last two days the pain had been continuous. She had had typhoid as a child and had

borne ten children, all now dead. She stated that she had been afflicted with frequent colds all her life.

Emaciation was extreme, jaundice was intense and she was markedly ateriosclerotic. She had poor sight, her teeth were all missing, a thyroid adenoma was present and the liver and gall-bladder were enlarged and tender.

Laboratory examinations showed a 4 plus Kahn, basal metabolic rate of plus 4, and a Van den Bergh of 4.38; the feces contained no bile, the urine was positive for urobilinogen in 1–10 as well as full of bile, and the *x*-ray showed no shadow after the Graham dye test.

After admission the patient developed Charcot's fever and the pain and jaundice became worse. She improved somewhat and then became worse again, so that, on October 24, she was transferred to the surgery service, where she was given intensive preoperative care and operated upon. Stones were found in the gall-bladder and the ampulla of Vater which were removed, and the gall-bladder and common duct were drained. Blood transfusions, fluid by vein and skin were given and she was relieved of the chills but died a few days later. Autopsy revealed pyelephlebitis with cholangitic abscesses.

Case iv. Carcinoma of the pancreas.

An Indian male, age 33, about one month before admission, on November 24, 1934, noted jaundice and hoarseness, and a lump in the left side of his neck. About the same time the stools became light and the urine dark. During the last four months a loss of 33 pounds had occurred. He gave no history of tuberculosis or lues but he had always been a hard drinker. Fifteen years before he had had malaria, rheumatism and appendicitis.

He came to the hospital because of colic although the above findings were also present and he also had a small left pupil and a large gall-bladder and liver. The Van den Bergh was 20, but other tests, including an *x*-ray of chest, were normal.

Laparotomy, December 1st, showed a distended gall-bladder and carcinoma of pancreas, for which cholecystostomy was done, but he died later.

Case v. Stricture following removal of common duct stone.

A white female, age 34, had a cholecystectomy in April 1933 for stones, a few days after which she developed colic and jaundice and continued to have attacks up to admission on September 18, 1934. No fever or chills had ever occurred, but she had lost 17 pounds in weight.

The only laboratory findings of value except those of jaundice were a blood cholesterol of 495 and the obtaining of bile by duodenal drainage.

On October 4, a small stone was removed from the common duct and a T-tube inserted, but drainage and jaundice persisted. Lipiodol was injected through the T-tube, revealing obstruction of the duct. Operation was again done, but adhesions were so dense that the drainage tract was anastomosed to the duodenum over a catheter held in place by a silk suture. Complete recovery followed.

Case vi. Stone in the common duct.

A white female, who for twelve years had suffered from attacks of colic, was admitted September 18, 1934 with fever, jaundice and pain, but without chills.

Except for obstructive jaundice, the laboratory tests were negative and since the fever continued, and her condition was poor, a rapid cholecystostomy was done September 22. Many adhesions were noted and the gall-bladder was very thick. The next day, the patient developed dulness at the right lung base and for two weeks ran a fever, during which time drainage was poor. On October 19 and again on October 25, she had a chill, followed by an increased jaundice. Lipiodol was injected into the tube and showed duct obstruction. Operation was again done and a stone was removed from the common duct. Drainage, both of the duct by a T-tube and of the gall-bladder by a catheter, was instituted. Complete recovery followed.

Case vii. Diffuse carcinoma of the common duct.

A diabetic white female, age 57, was admitted October 16, 1934, with pain in the right upper quadrant and back of two weeks' duration. She complained of belching and fulness after eating of two months' duration. No fever, chills or sweats had occurred, but there had been loss of definite weight.

On examination she was obese; her teeth were missing; she had no jaundice; and *x*-ray studies revealed gallstones, but otherwise a normal gastrointestinal tract. All laboratory tests were normal.

Cholecystectomy was done November 2, after which auricular fibrillation occurred, which was treated by digitalis and carotid sinus pressure. The woman recovered and went home, but in December returned with all the

above symptoms, plus jaundice. Operation was again done after four days' preparation. Many dense adhesions were found. The common duct, which was hard, firm and rigid, like a tube, looked as if a diffuse primary carcinoma had developed in it. The duct was incised and a ureteral catheter, the largest tube that could be inserted, was passed. Digitalis and insulin were used postoperatively in conjunction with transfusion of blood and fluid by vein, and the Wangensteen apparatus was used. Bile drained through the wound, but the patient died. Autopsy was refused.

SUMMARY

1. No one symptom of obstruction is diagnostic. Since two conditions may be present, local pathology may show and general affections may be missed.

2. A marked jaundice with clay-colored stools is usually significant of common duct obstruction, most likely due to cancer of the pancreas or bile ducts, chronic pancreatitis, gallstones or catarrhal jaundice. Transient jaundice, in the young, is usually catarrhal.

3. A large liver, with jaundice, most often shows common duct obstruction, lues, cancer, abscess, cirrhosis or poisoning.

4. Any jaundice should be relieved by palliative means as much as possible before surgery is done, inasmuch as the more nearly complete the obstruction is, the more the danger of cholemia. Early thorough treatment spares the liver, pancreas and kidneys. A slow pulse, in jaundice, is usually not present unless chronic pancreatitis occurs. If, with the jaundice, findings point to an essentially complete obstruction, the likely causes are tumors of the ducts or pancreas, stricture, or an accidentally ligated duct.

5. Fever may be present with the attacks due to an infected gall-bladder, but when the hepatic ducts are infected, a continuous fever may result. Charcot's fever means cholangitis as a rule, although jaundice, fever and rigors can follow pylephlebitis and hepatic abscess; malaria and sepsis might give a similar picture.

6. Biliary stones are often found post mortem. Icterus neonatorum has been caused by stones. Females who have been pregnant or had typhoid often have stones form in the gall-bladder and twenty per cent of them have common duct stone also, which usually gives a small gall-bladder with colic and jaundice. There may be no pain or jaundice, however, and the gall-bladder may be enlarged, especially if the cystic duct is blocked.

Stones may accompany tumor or stricture. If jaundice follows right upper quadrant pain, it most likely is due to common duct stone. Recurring jaundice in a middle aged woman, with or without colic, is almost pathognomonic of the same; chronic pancreatitis alone may confuse. Should pain occur without jaundice after cholecystectomy, it calls for duodenal drainage and examination of the bile for crystals of cholesterol and calcium bilirubinate.

7. Tumors of the pancreas and biliary ducts usually give a painless jaundice with an enlarged gall-bladder, although pain, Charcot's fever, or a small gall-bladder may be present. Early diagnosis and treatment are imperative, because benign lesions may become malignant, and all malignant growths of the duct metastasize slowly. Carcinoma is more frequent in males, while stones form more frequently in females. Recurrences of jaundice for years is against malignancy, but on the other hand, a middle-aged person with loss of weight, having a history of short duration, together with a deep persistent jaundice without colic, and an enlarged gall-bladder, is almost surely suffering from carcinoma of the pancreas or the bile ducts.

8. Pylephlebitis and cholangitic abscesses cause death, and diabetes is a very serious complication. Vocal cord paralysis may be dependent upon Ewald's node which might be the first sign of abdominal malignancy.

9. Spinal anesthesia spares the liver, while ether, chloroform and avertin may further injure it. A fall in blood pressure is

met by the Trendelenburg position combined, if necessary, with adrenalin or ephedrine by hypodermic, 50 c.c. of 50 per cent glucose by vein, a few whiffs of ether combined with artificial respiration, and even massage of the heart and adrenals through the abdominal wound.

10. In the operative work the gall-bladder should always be left in until it is made sure that the duct is all right. The duct should be explored in all suspicious cases, after needling it to be sure the portal vein is not entered; a stone may not be palpable if the duct is thick. It should be opened if there is or has been jaundice, and probed with a uterine sound. Suction, should be used if necessary. Then the duct should be wiped out with gauze, and drainage inserted.

Fistula of the duct into the gut calls for operation in most cases.

The duodenum should be opened, if necessary, and if a condition is found which prohibits further surgery, the gall-bladder can be anastamosed to the duodenal wound. A stone in the ampulla may require transduodenal removal, if it cannot be removed through the duct above the duodenum. Tumors of the ampulla may be removed transduodenally and the duct reimplanted into the duodenum.

11. Postoperative hemorrhage may be lessened by the use of blood transfusions before operation in conjunction with parathormone hypodermically, calcium chloride by vein, and duodenal drainage. Bile pigment is said to fix the calcium of the blood. Purpuric spots and increased sedimentation rates are indications for blood transfusions before operation.

Prostigmin has recently been added to the armamentarium for the care of postoperative distention.

Atelectasis after operation is more frequent following biliary surgery than any other type except gastric, and its incidence can be reduced by rebreathing of carbon dioxide and oxygen, deep breathing exercises, and frequent changing of position. Slapping the back sharply will often help loosen a plug of mucus from the bronchus.

After release of obstruction, the bile for a few days shows absence of bile salts, increased calcium, and decreased sodium chloride content. If dehydration and loss of weight occur from loss of bile, the latter can be re-fed to the patient in grapejuice or given by rectum.

Lipiodal through the drainage tube may be used to reveal the state of patency of the ducts, in cases not progressing normally.

This paper was prepared at the direction of Walter Estell Lee, M.D., Vice-Dean of Surgery, of the Graduate School of Medicine of the University of Pennsylvania. It is being published with his permission, for which I wish to express my deepest appreciation.

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HIGH LIGATION OF CYSTIC VESSELS IN SUBSEROUS CHOLECYSTECTOMY*

THE USE OF SILVER CLIPS

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SUBSEROUS dissection[1] is the safest and best for cholecystectomy. This is true for the chronic stone-bearing gall-bladder, and has been emphasized recently by MacGuire[2] for the acutely inflamed vesicle. In removal of a cyst from the tissues, the surgeon works as close to its wall as possible, the only method which insures against damage to surrounding structures. The same principle holds for cholecystectomy, since dissection close to the wall of the gall-bladder prevents damage to the liver, hepatic artery or bile ducts, and with proper methods, avoids hemorrhage from the cystic artery. In subserous cholecystectomy, particularly from above downward, the surgeon is always on safe ground. By the time the dissection has reached the cystic duct the main hazards are pushed aside and the only structure left to be concerned with is the common duct. This can be exposed cleanly and safely at its junction with the cystic duct. The junction, a favorite lodging place for stones, can be palpated; or the cystic duct can be opened and in many cases the common duct probed through it; or the stump can be used for drainage, according to Sweek.[3]

Subserous dissection from above is possible in about one-half the cases; in the other half the serosa is too adherent. With this method a smaller incision can be employed and through it a better exposure obtained than by a larger incision when using the method of removal from below upward. After preliminary exploration of the region, the other viscera can be walled off and self-retaining retractors placed. The packing does not have to be shifted continually as is the case with dissecting cystic artery and duct in a deep hole under difficulties of vision and approach. In addition to easier and safer surgical procedure, the patient has the advantage of easier and quicker recovery—out of bed in seven days.

Dr. William Mayo has said that every additional inch added to the abdominal incision increases the patient's stay in the hospital by several days. With a smaller incision the patient can breathe better and move better. If a large incision is made, the liver dislocated, and trauma to other viscera increased, there is more danger of pulmonary or subdiaphragmatic complications, post-operative distention, and later, adhesions and herniation.

Let it not be assumed that I am advocating a small abdominal incision regardless of circumstances. A surgeon must be able to see well and work easily, surely, and safely. With subserous cholecystectomy and the modification to be described, this is as readily accomplished through an incision of 4 to 6 inches as with one 8 to 10 inches long.

The difficulty in removal of the gall-bladder from above downward has been in control of hemorrhage. This is not dangerous, as it would be from a free flowing cystic artery in the depths of the abdomen when below-upward dissection is used, but it is a troublesome oozing from small branches, interfering with vision in dissection. Control of this hemorrhage, particularly in subserous cholecystectomy, can be easily attained by taking advantage of one anatomic point: *the cystic arteries run on, not in, the wall of the gall-bladder.* In other words they are subserous. By the use of

* From the surgical clinic of the Portsmouth Hospital, Portsmouth, N. H.

proper instruments they can be dissected up readily, with their strands of supporting fibrous tissue, and ligated.[4]

jawed Collins clamp and is pulled up. If the serosa is glistening and the gall-bladder is not shrunken and fibrotic, subserous

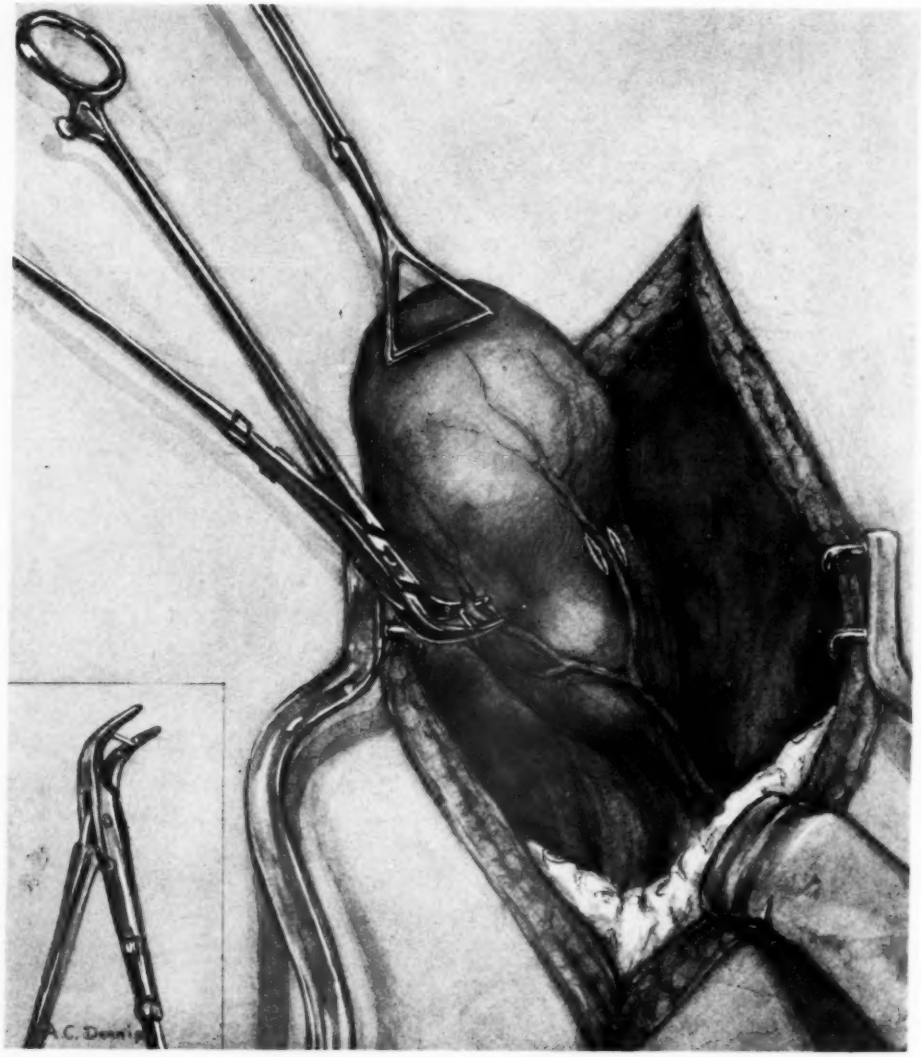

FIG. 1. Dissection of cystic vessels off the wall of the gall-bladder through slits in the serosa, and application of silver clips. One arm of the clip rests flatly in a groove on the dissecting jaw of the clamp. Insert shows the flange on the other arm of the clip which slides along the groove in the other jaw of the clamp and clasps the tissue firmly as the clip is closed.

The *technique* of a method for subserous cholecystectomy, utilizing the fact that the cystic artery branches under the serosa, will be described, and the use of modified Cushing silver clips for hemostasis will be illustrated.[5]

After the stomach, duodenum and colon have been packed away and self-retaining retractors placed, the fundus of the gall-bladder is grasped by a soft, triangular-

dissection can generally be done. In the case of acute inflammation, if the vesicle is distended and not gangrenous nor densely adherent to other viscera, the serosa will often strip. In any case this can be tested through an incision at the fundus near the liver edge.

A word should be said here with regard to surgical treatment of acute cholecystitis. *If the inflammation is pronounced or ad-*

vanced the vesicle should be drained, not removed by any method. In some mild cases subserous dissection will work well; in a few others where this cannot be done, particularly if a moderate acute reaction is superimposed on chronic fibrosis, electro-cholecystectomy,[6,7] through control of hemorrhage, is simple and safe, and does away with the necessity for a second operation. But in advanced acute cholecystitis with involvement of adjacent structures, the safest method is drainage with as little breaking down of the protective wall as possible. The author has devised an electrosurgical method whereby a virtual cholecystectomy can be performed through fulguration of the mucosa—electro-cholecystocausis.[8]

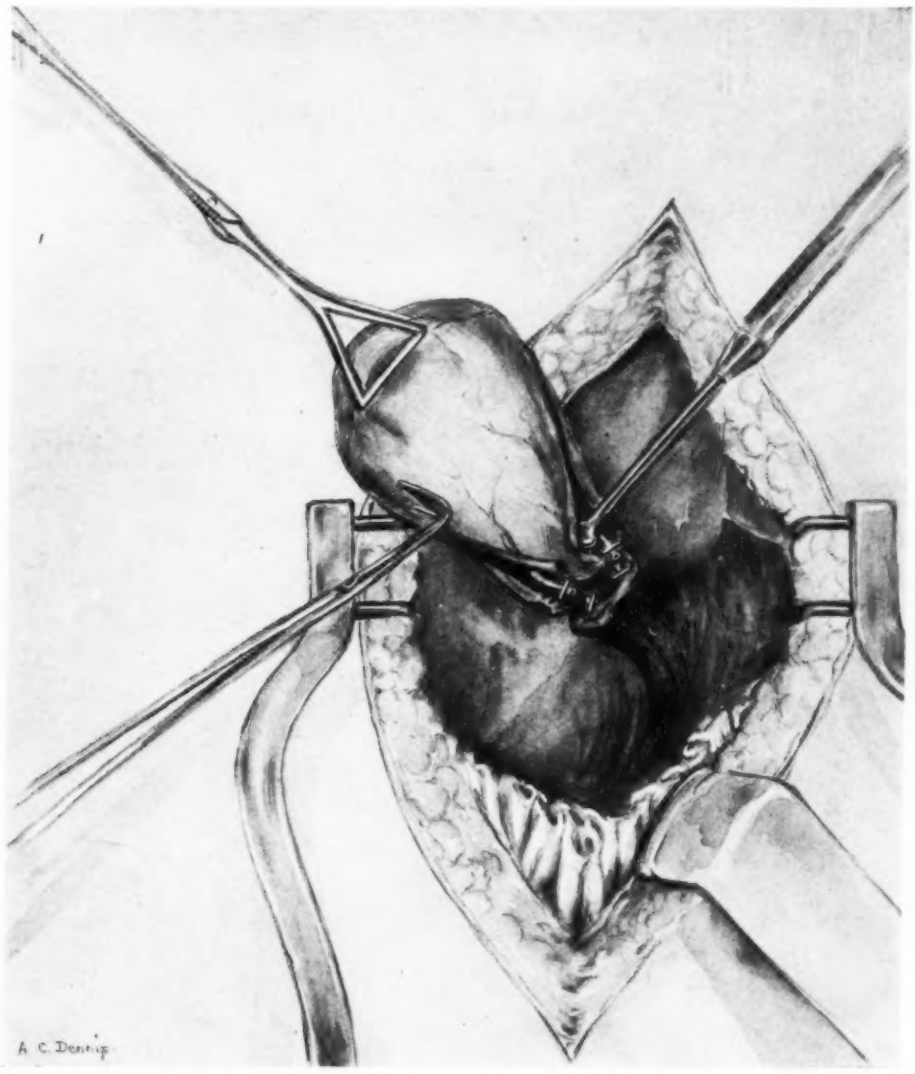

Fig. 2. Clips holding cut cystic vessels. On the left are shown right angled scissors dissecting and cutting serosa; on the right is the Walker suction dissector in action.

If the serosa can be dissected, the first step in the method under discussion is to secure the branches of the cystic artery: With a sharp knife, short incisions are made through the serosa along two to four main branches of the cystic artery on the lower third of the gall-bladder at points readily accessible. Then each vessel, with

its supporting strand of tissue, is dissected up with one jaw of the clamp carrying the silver clip. (Fig. 1.) The slip is applied by closing the jaws of the clamp tightly. The stiff wire of the clip with the flange on one end (Fig. 1, Insert) holds it securely. Then with right-angled scissors the vessels and serosa are cut across the front of the gall-bladder above the clips. The serosa is slit up along the sides and over the top about 1 or 2 cm. from the liver. (Fig. 2.) The right-angled scissors are specially made for this purpose; they have short jaws and rounded tips, the sharp points at the ends of the cutting surfaces having been ground off so that they will not tear the serosa. Usually one tip can be inserted under the serosa and with the jaws fixed and slid along, the serosa can be dissected up and cut around the liver margins. There will not be much bleeding. If a spurter is encountered it can be stopped with a silver clip.

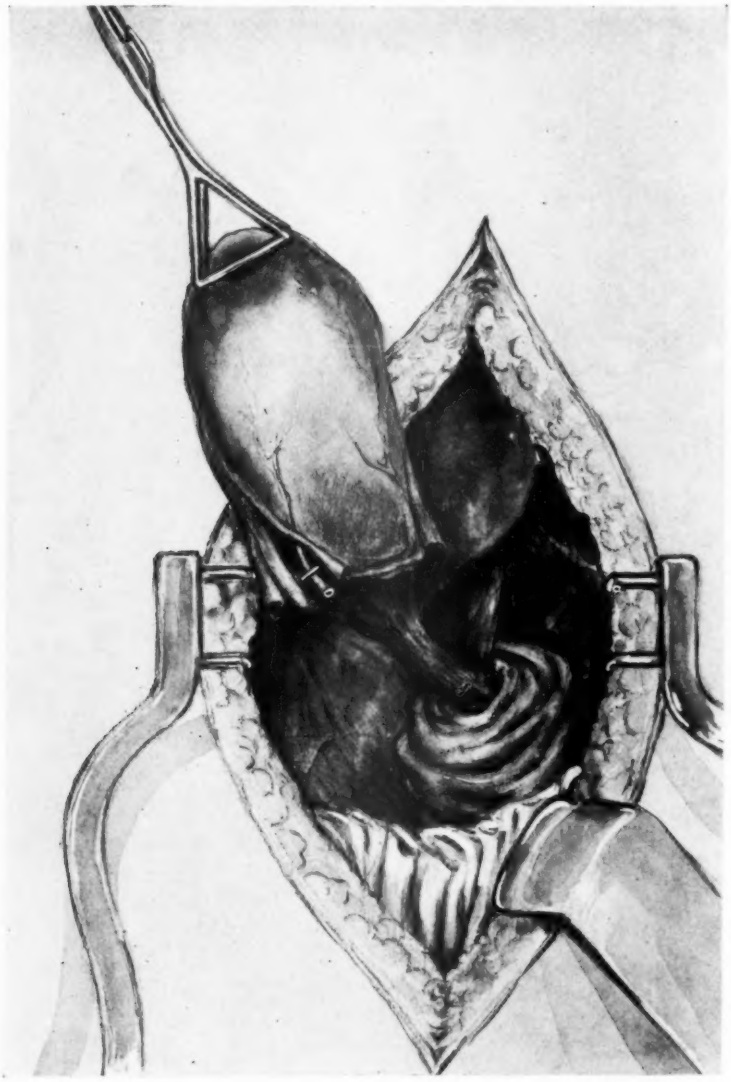

FIG. 3. Peritoneal cuff (somewhat diagrammatic) dissected to junction of hepatic and cystic ducts. The clipped stumps of the cystic vessels have been carried down with the cuff and are a safe distance away. The gall-bladder has been dissected from the liver bed and is free to the ducts, which can be easily explored.

After the serosa is cut around the margins, dissection proceeds from above

close to the gall-bladder. Clifford Walker's suction tonsil-dissector is a great help. (Fig. 2.) In the gall-bladder bed there is a definite, rather firm layer of fibro-areolar tissue which should be left on the liver. With scissors it can be cut close to the gall-bladder without hemorrhage. The dissection is carried down on all sides, separating the cuff of serosa with the stumps of the clipped vessels on the front. (Fig. 3.) If definite firm strands of tissue are encountered anywhere it is best to clip them since they may carry branches of the artery.

When the cystic duct is reached, all dangerous vessels are to the side. Strands of tissue near the duct are cut with impunity, and the cystic is cleared to the common duct. The few small vessels near the common duct are brushed away without much bleeding.

The junction of the cystic and common ducts should be thoroughly palpated. It is a favorite lodging place for stones. Even a small one left here will cause a recurrence of biliary colic and necessitate a second operation.

If there is a reasonable suspicion of stone in the common duct, such as a history of recent jaundice, or marked vomiting associated with biliary colic,[9] and if dilatation of the duct is present, it should be explored. A little bile can be allowed to well out of the stump of cystic duct; if clear there is probably no débris in the passages. If bile will not come through the cystic duct the common duct can be aspirated with a fine hypodermic needle. Should exploration of the common duct be decided upon, the safest method is to do it through the stump of the cystic duct. If this is too narrow it can be split down the front into the common duct. After probing (and dilatation of the sphincter of the common duct) this slit can be sewed up over a catheter in the cystic duct with little damage to the common duct. Sometimes it is more feasible to incise the common duct below the stump of the cystic.

If there is no indication for exploration of the common duct, the cystic duct is milked upward, cut off about 1 cm. from the common duct, and the stump left loose. If a drop of clear bile can be expressed, proving it free of stone, the stump is doubly tied with O chromic catgut.

With the cystic duct thus secured, and in the absence of bleeding from vessels or oozing from the liver bed (which should have been left covered with areolar tissue) or damage to the liver elsewhere, the wound is not drained. If feasible, the peritoneal tissue cuff (Fig. 3) is pulled up over the stump of the cystic duct, and this and the cut edges of serosa whipped together over the gall-bladder bed.

Omission of drainage applies only to those cases where acute inflammation is absent and where the perfect conditions mentioned prevail. With the acutely inflamed gall-bladder, whether removed subserously or by electrosurgery, the wound should be drained.

SUMMARY

The advantages of subserous cholecystectomy are: (1) facility of operation through a small incision; (2) greater safety, particularly in the region of the cystic and common ducts; (3) quicker and easier recovery of the patient (seven days in bed); (4) fewer complications.

The chief difficulty in subserous cholecystectomy is in control of hemorrhage from numerous small vessels; this can be readily accomplished by the use of modified Cushing silver clips as described:

At about the lower third of the gall-bladder slits are made through the serosa beside the several branches of the cystic artery. The vessels are dissected up and silver clips applied with the clamp for this purpose.

The serosa and vessels are cut across above the clips and the serosa along the vesicular margins.

The gall-bladder is stripped from above to the junction of the cystic and common ducts, which is palpated. The common duct can be explored and drained through the

cystic stump, with a slit into the common duct if necessary.

With the chronic gall-bladder, where a definite, clean stump of cystic duct is doubly tied, and there is no oozing of blood or damage to the liver, drainage is omitted; with the acutely inflamed gall-bladder, drains are used.

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Submucous myomas may cause excessive bleeding, anemia and dysmenorrhea without attaining great size.
From—"Diseases of Women" by Paul Titus (National Medical Book Co.).

ENTEROGENOUS CYSTS

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ANY tissue that has the anatomic structure of an organ, complete or incomplete, must of necessity come from such an organ. Enteric or enterogenous cysts are rare congenital developments from the intestine. They show all criteria of this development with their mucosal epithelial lining in various stages of degeneration, a submucosa, two layers of muscularis and serosa. These cysts contain a mucinous material varying in color from a grayish white to a yellowish brown. The amount of fluid depends on the size of the cysts, which vary from that of a cherry-stone (Heuter's case) to 8200 c.c. (a case reported by Fehleissen).

CASE REPORT

A female child, age 4 years, was admitted to the Royal Hospital on January 6, 1937, at 8 P.M., with a history of pains in the abdomen associated with frequent vomiting. She had vomited approximately fifteen times since early that morning, and arrived at the hospital in an apparently exhausted condition, with a temperature of 98.6 degrees.

Laboratory findings were as follows:

Blood	
Hemoglobin	60 per cent
Erythrocytes per c.mm.	3,440,000
Leucocytes per c.mm.	8,400
Poly. neutrophiles	87 per cent
Small lymphocytes	13 per cent
Urine	
Color	Yellow
Appearance	Cloudy
Reaction	Alkaline
Specific gravity	1,030
Albumin	Negative
Sugar	Negative
Crystals	Present
Pus cells	Occasional

Examination revealed a well developed female child, with heart normal, lungs clear, and abdomen somewhat distended throughout. A mass apparently the size of a tennis ball, slightly movable and tender, situated in the right lower quadrant, was observed. Bowel movement had been minimal that morning. No apparent blood was observed by the mother and none was observed on rectal examination at the time of admission. A diagnosis of acute intestinal obstruction associated with intussusception was made and a laparotomy was performed immediately.

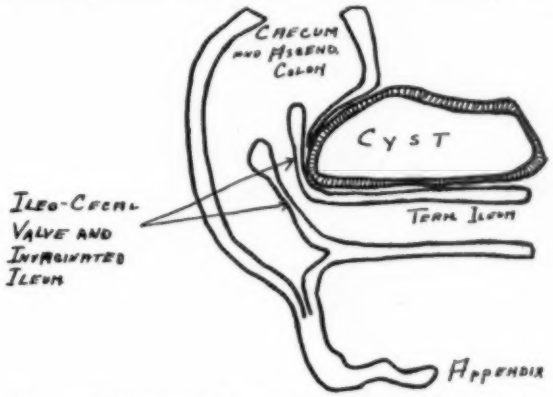


FIG. 1. Diagrammatic gross representation of the pathology.

Past History. The patient had had whooping cough one year previously, but otherwise no early childhood diseases. Six months previous to the present illness the child complained of pain in the stomach associated with cramps and a desire to move her bowels. She vomited once at that time. Three months later there was a typical recurrence of this episode. During her first attack the patient had a bloody stool. During the second attack there was absolutely no stool for twenty-four hours.

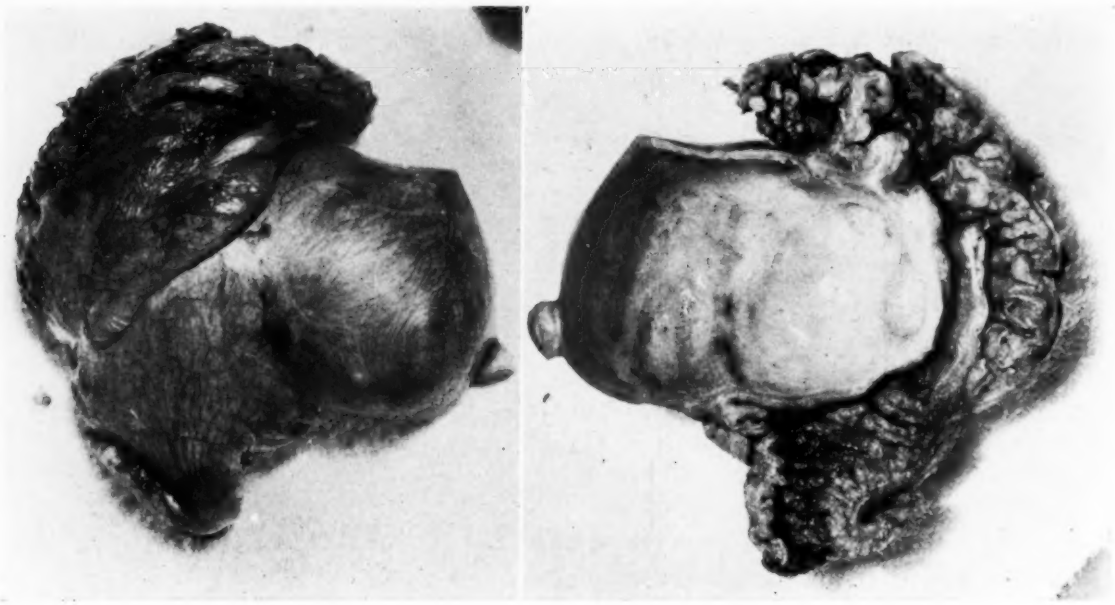
Operative Findings and Procedure. Postoperative diagnosis was a tumor of the ileocecal junction, with questionable malignancy. Preoperative diagnosis was acute intussusception.

Gross findings were a cone-shaped mass, cystic, the size of a large lemon, situated at the junction of the ileum and ascending colon between the leaves of the mesentery. A number of smooth mesenteric lymph glands extended upwards and medially towards the liver.

A 4 inch right mid-rectus incision was made through the peritoneum, and the above

pathology was then identified. Two inches proximal to the ileocecal junction the ileum was clamped, cut across and inverted under

"The cyst is pear-shaped and very tense, and its contents cannot be expressed into the lumen of the bowel. The serosal surface



A B

FIG. 2. Pericecal cyst, anterior half, cut section and surface views. A, anterior surface and B, cut section. The ileocecal valve is clearly seen to the right of the cyst, about one-fourth inch above its middle. The ileum enters below and the ascending colon emerges above. Natural size.

double purse-string linen suture. The peritoneum was incised along the white line of the ascending colon; the ascending colon and hepatic flexure were freed, with the posterior parietal peritoneum and glands intact. The transverse colon was grasped just beyond the bend of the hepatic flexure, cut between clamps and inverted under a double purse-string linen suture. The tumor mass with the colon was removed intact; a lateral anastomosis was established between the ileum and the transverse colon. A cigarette drain was inserted to the right lumbar gutter. After all sponges and lap pads had been accounted for, the incision was closed in layers.

Pathologic Examination by Dr. Joseph C. Ehrlich.

"*Type of Specimen:* Appendix and portion of bowel, lymph nodes.

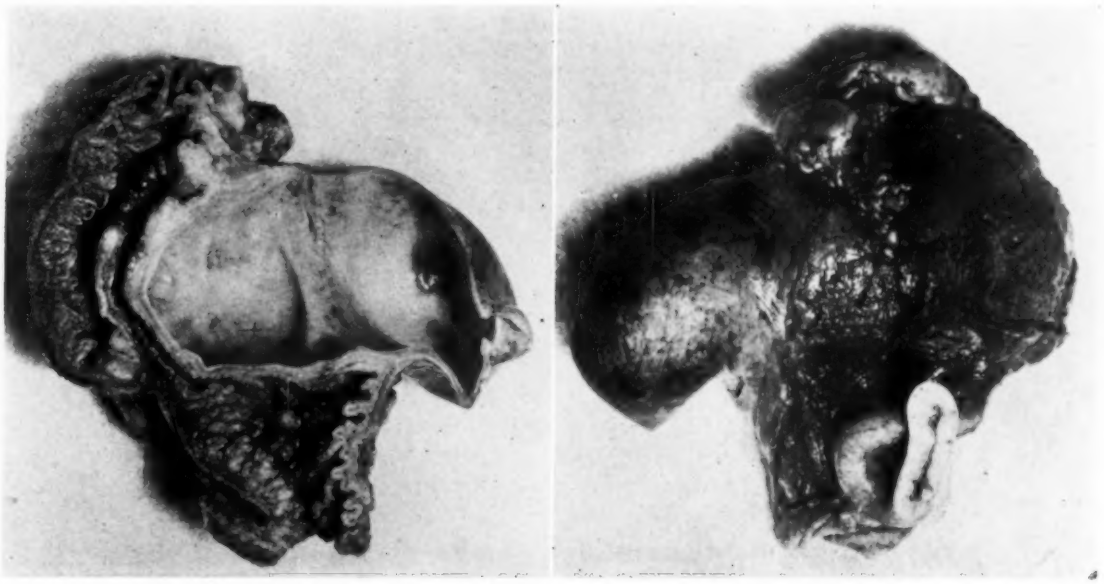
"*Gross Findings:* Specimen consists of the terminal inch of ileum and cecum and ascending colon for a distance of 2 inches. A coiled appendix 2½ inches long is present in the normal location. In the angle formed by the superior surface of the terminal ileum and medial surface of the ascending colon there is a cyst which measures 2½ × 1¼ × 1¾ inches.

of the cyst is markedly injected and the wall of the cyst is thick and firm and fibrous in consistency. The cyst contains about 35 c.c. of fluid of the appearance and consistency of glycerine. The cyst lining consists of shiny, smooth, grayish-white membrane. The cyst has a single cavity with one or two small, valve-like pockets which have blind endings. There are some petechial hemorrhages present in the lining of the cyst. This cyst has produced marked pressure on the ileocecal valve, which is flattened out against the lateral wall of the cecum and which has been invaginated with a small portion of the terminal ileum into the cecum for a distance of 1 inch.

"The muscular and mucosal coats of the ileum and cecum and ascending colon do not show any changes, except for some hypertrophy. The nature of the pressure on the ileocecal valve is such as could produce partial intestinal obstruction. The appendix is essentially normal in appearance, except for moderate serosal congestion. Two lymph nodes were also received, each about 1 cm. in diameter, and were sent through for microscopic examination.

"*Microscopic Findings:* Section of the cyst reveals it to be lined by markedly thinned out

and flattened mucosa of the intestinal type, which, from the clusters of mucous cells present, appears to belong to the large intestine. There



A B

FIG. 3. Pericecal cyst, posterior half, cut section and surface views. A, cut section and B, posterior surface. The appendix is seen clearly in the surface view. Only a small portion is visible in the cut section view. Natural size.

is a muscular coat which is typical of intestinal muscularis and also a thin serosal coat of the type belonging to intestinal wall. The adjacent ileum contains numerous very large lymphatic cell collections with germinal centers which belong to Peyer's patch. The wall of the colon appears normal.

"Section of lymph nodes of the mesentery reveals hyperplastic nodes with numerous large germinal centers. No definite active inflammation is present.

"Section of appendix reveals some lymphoid hyperplasia.

"*Diagnosis:* (1) Terminal ileum and cecum with closed off congenital intestinal diverticulum in the ileocecal angle, producing partial obstruction at the ileocecal valve. (2) Lymphoid hyperplasia of appendix. (3) Hyperplastic lymph nodes."

Postoperatively the patient had a very stormy course for the first five days, with temperature elevated to 106 degrees and pulse between 140 and 160. A number of infusions were given but no transfusions because of the exceedingly high temperature. The patient finally rallied and from the sixth day on, her temperature came down within the normal range. She was discharged on the nineteenth day postoperatively.

During her illness at the hospital the patient lost 15 pounds. From January 23, 1937 to February 9, 1937, she regained about 3 pounds.

DEVELOPMENT OF ENTEROGENOUS CYSTS

Site of Development. Enterogenous cysts have been found in the thorax and in the abdominal cavities, apparently developed from the esophagus, stomach, duodenum, jejunum, ileum, or sigmoid. Two very rare cases, reported by McLanahan and Stone, apparently developed from the rectum. Cases are on record where in the same individual a thoracic and an abdominal cyst have been found. The most common site of enteric cysts is in the cecal area, but they are also to be found in the duodenum and jejunum. These cysts may occupy any part of the intestinal wall: the submucosa, the musculature or the subperitoneum. They may occupy any plane of the gut either antimesenteric or mesenteric. In the latter position they may be closely approximated to the gut wall or some dis-

tance from it between the leaves of the mesentery. The cysts which are found a distance away from the wall of the gut may find their attachment by fibrous bands to the liver or to some other organ.

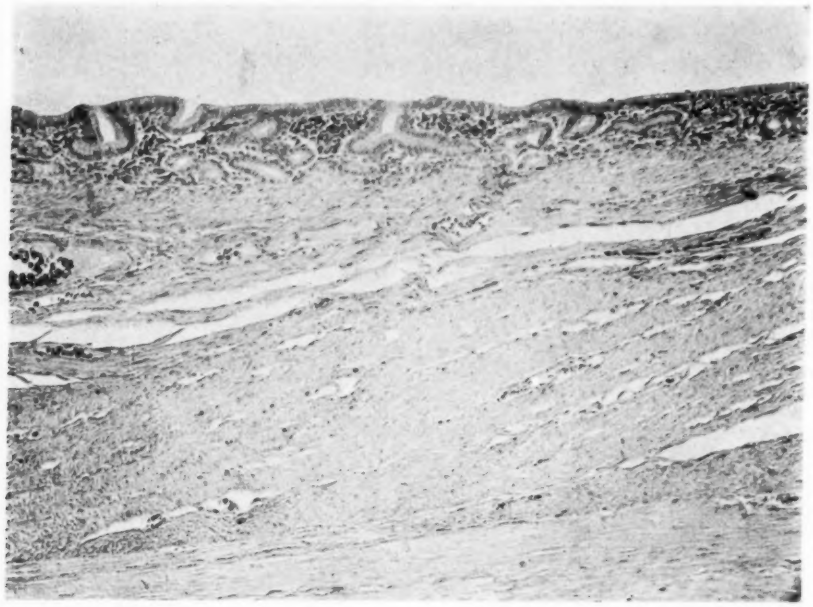


Fig. 4. Cyst lining and wall under low power. The epithelium is stretched out intestinal mucosa. Glandular structures still persist. There is a distinct submucosa and muscularis present.

Theories of Development. Of great importance in our knowledge of the theory of development of these cysts is the understanding that congenital intestinal diverticuli and enterogenous cysts have the same anatomic structure. Their difference lies in the fact that diverticuli communicate with the lumen of the gut while cysts do not.

Lewis and Thyng, in a study of the intestinal diverticuli in the embryo of the pig, rabbit and man, demonstrated knob-like diverticuli in the duodenal region in a 5.5 mm. to 14 mm. pig and also found such diverticuli in the small intestine in the 14 to 24 mm. pig. In a 32 mm. pig, they demonstrated a number of diverticuli in the ileum. These diverticuli, which appear first in the duodenum, begin as round knobs and many elongate and detach themselves from the intestine in the form of nodules, strands or cysts. The rabbit embryo shows practically the same development. In a 23 mm. human embryo they found thirty-three well developed diverticuli in the small intestine. From this development, it is readily conceived how the lumen of a diverticulum may close and obliterate its communication with the bowel and form an enteric cyst. From this development one may understand how enterogenous cysts may occupy any portion of the intestinal wall or any of its planes, or even how they may develop in between the mesenteric folds a distance away from the original host.

There are cysts or diverticuli which arise in connection with the obliterated portion of the vitello-intestinal duct. This theory is probably the most popular among pathologists, and was first advocated by Fitz in 1884. At the end of the fourth week of intra-uterine life the midgut has become tubular and communicates with the yolk sac. At the end of the sixth week the vitello-intestinal duct and the accompanying vessels of the superior mesentery atrophy. A true Meckel's diverticulum, usually situated 12 to 14 inches from the ileocecal valve, develops from such an incomplete obliteration of this duct on the

anti-mesenteric side of the bowel. Remnants of the vitello-intestinal duct may remain between the intestine and umbilicus. Cysts may form anywhere along these points or diverticuli with cysts may develop along the same route. As has been said before, the most popular theories state that all enterogenous cysts develop from the improper obliteration of the vitello-intestinal duct.

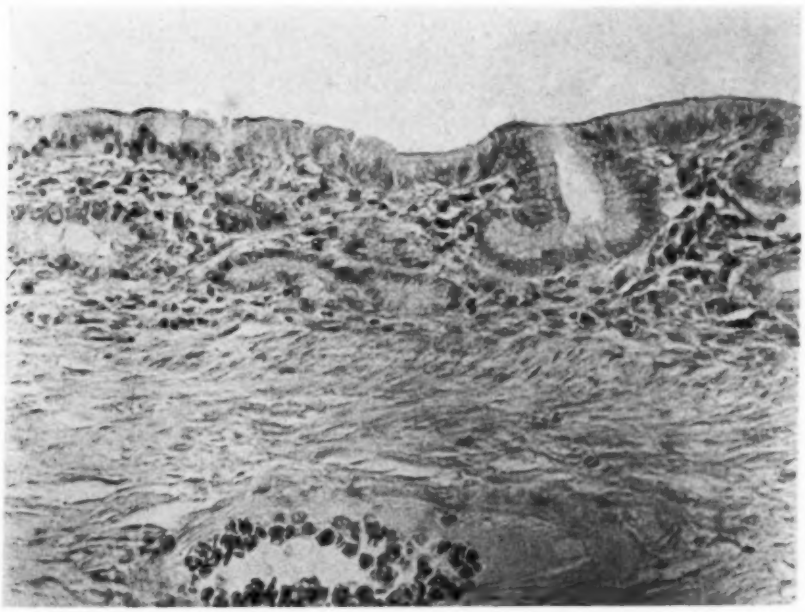


Fig. 5. Cyst lining under medium power. The mucosal epithelium is of the tall columnar type, with basal nuclei and secretory droplets. The submucosa and muscularis are clearly seen.

Edwards (quoting Gfeller) regards the cysts as arising in connection with an unobliterated omphalo-mesenteric duct, either by separation of a part of the intestinal anlage or by germinal displacement.

Terrier and Lecène mentioned that they might be produced by snipping off, pinching or incarceration of a piece of intestinal wall during early fetal life. It is a well known fact that aberrant Wolffian and other cysts occur in this manner and are found a great distance from their parent structures. Black and Benjamin also take note of this fact.

Cyst Lining Variation. On the whole in enteric cysts and diverticuli the entire structure from mucosa, submucosa, muscularis and serosa can be identified as intestinal morphology. In these structures the greatest variations or changes occur in the epithelial lining. These may show stratified cylindrical cells, atrophic columnar, stretched columnar, flattened, etc. Formation of villi may be complete or incomplete. These changes, according to Evans, can be accounted for by the intracystic tension or inflammatory changes, or may be explained by the embryologic development of the gut.

Heterogenous Cysts. Kollman stated that the epithelium of developing intestine undergoes regular progression from simple cuboidal to simple cylindrical to stratified epithelium from which finally develops the permanent layer of simple cylindrical epithelium. What determines this steady progression to a state of specialized epithelium is not known. In detached epithelium under different environment many various factors may either stimulate or inhibit these cells and give an altogether different cell formation from its original specialized form. For example, time and again gastric cells have been demonstrated in Meckel's diverticuli and esaphageal cysts. Gfeller reported a case where he

found several varieties of cells in the same enterogenous abnormality. Black and Benjamin report a case in a 5½ month male child who died of a peptic ulcer at the site of the diverticulum in the proximal connection with the jejunum.

Reduplication. On close analysis of the literature the fact develops that this phenomenon undoubtedly is no different from the development of diverticuli. In fact, it is comparable to the formation of giant diverticuli growing between the leaves of the mesentery in close proximity to normal gut wall—thus, in such a position, partaking of part of its blood supply. According to Fitz it is the result of the persistent growth of the vitelline duct.

Symptoms. Cysts and diverticuli are found in any age from infancy to senility. The symptoms naturally depend on the age, size and site of the growth. Most often these tumors have been found at autopsy or accidentally at some operative procedure and have been shown never to have produced any untoward symptoms during life.

The symptoms are usually those of local pressure, giving pains or aches, with signs of intestinal obstruction, either through direct compression or from kinking of the bowel by its own weight or its twisting as in volvulus.

Differential Diagnosis. The correct diagnosis preoperatively is most unusual. In the child with a mass in the right lower quadrant the diagnosis between acute appendicitis and intussusception is most often considered. Acute intestinal obstruction is the next most common diagnosis.

Treatment.

1. The operation of choice is enucleation of the cyst. This is most often possible when the cysts are situated in the mesentery or retroperitoneally a good distance from the gut.

2. The second choice would be excision of the bowel, as in my case, with anastomosis. Here the mortality is usually very high because such an extensive operation has to be performed in the early span of life.

3. In very large cysts, marsupialization may be a method of choice, especially where the mass is so large that enucleation or anastomosis is not feasible or where the general condition of the patient is precarious.

SUMMARY

This case of an enteric cyst is presented, first because of its extreme rarity, and second for the many interesting theories of development that can be followed from the embryologic state to the pathologic culmination.

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CARBUNCLE*

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THE skin offers a remarkable protection for us and bears the brunt of our contacts with trauma and microorganisms. Its immunity must be high and its reparative powers great or we should soon be annihilated, since the integument is constantly covered with bacteria. It contains many natural pits (sebaceous gland ducts, hair follicles, sweat gland ducts) to say nothing of those artificially created by injury. If these pits become closed, ample opportunity is present for the development of the familiar boil or carbuncle. It is well known that even after careful preparation of the skin for operation it remains grossly contaminated, for it is impossible and perhaps unwise to attempt complete sterilization.

Our study of carbuncle consists in: (1) a brief review of the microscopic anatomy of the skin and subcutaneous tissues on the neck and face in order that we may understand the paths which these infections may take; (2) a study of the immunology which permits the infection to occur and which finally overcomes it (local and general); (3) the surgical pathology which is manifested; and finally (4) the proper treatment in the light of clinical and statistical studies of different methods and their results.

A study of the low power photomicrograph of a section of normal skin taken from the back of the neck will show the depth of the hair follicles, sebaceous glands and sweat glands. It will be seen that they descend down into the subcutaneous tissue, but not into the subcutaneous fat. According to Warren:[1] "There would be no communication with the subcutaneous adipose tissue were it not for oblique columns of fatty tissue which extend upwards from below. These fat columns or columnae adiposae which are found beneath each hair follicle are of about the same width as the hair follicle—and they contain besides loose connective tissue, fat cells and vessels, the coil of a sweat gland suspended midway in the shaft." These columns then complete the pathway from the hair follicle through the subcutaneous fat down to the underlying fascia. (Figs. 1 and 2.)

Infection occurs as a result of a decreased local immunity plus the occlusion by sebaceous material, dirt or grease of the normal skin pits. The staphylococci multiply rapidly and soon a papule forms. At this stage a small area of necrosis is present (caused by toxins from the bacteria) surrounded by a zone of inflammation. Here the process may stop and resolution may occur, particularly if the obstruction is removed, either spontaneously or by the use of ether or other fat solvent. If the bacteria continue to multiply further, necrosis occurs, which calls forth more inflammation and which is followed by suppuration.

It is easily seen that when pus forms and goes down the columns of Warren, it cannot easily spread to the sides; it therefore goes deeper until some of it reaches the deep fascia whence it burrows along, finally seeking an outlet by ascending along other columns. (Fig. 2.) A sponge-like arrangement is thereby created with the "spaces" of the sponge filled with pus. Numerous exits are finally established in the skin, giving rise to its multiple draining sinuses.

On the face, the skin is also firmly attached to the underlying structure (panniculus carnosus or platysma in the neck) which continues upward as the muscles of

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expression. There is very little subcutaneous fatty tissue and the muscles are not involved. (Muscle tissue does not become

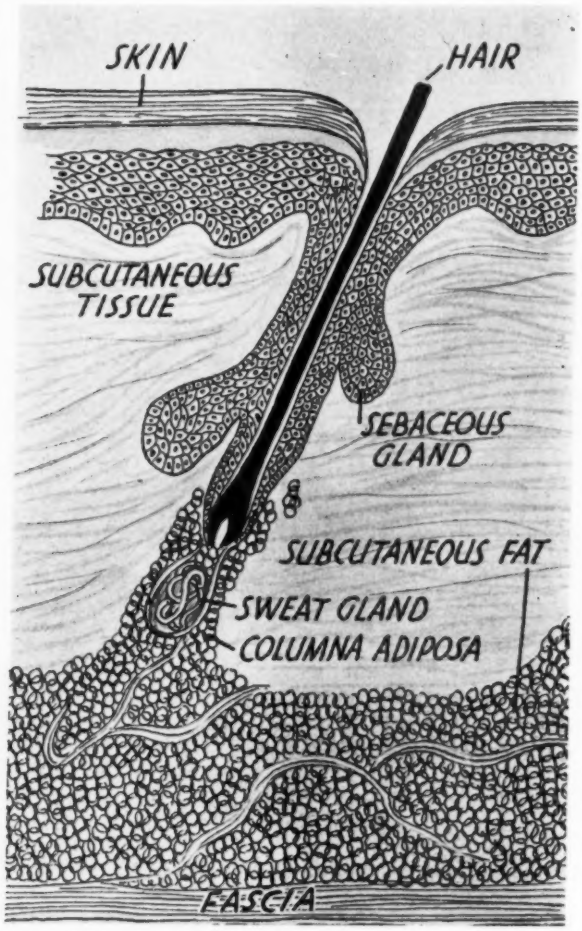

FIG. 1. Diagram illustrating hair follicle and columna adiposa.

infected unless injured or devitalized.) Consequently, pus does not break through into the mouth cavity or down to bone, but spreads laterally under pressure, causing phlebitis and thrombosis of veins and necrosis of the overlying skin. (Fig. 3.)

Since carbuncle is the result of a staphylococcic infection, an attempt is made at localization. This process is the same as occurs in all localized (as opposed to diffuse) inflammations. The wall that ultimately forms is a thick, living "pyogenic membrane" loaded with leucocytes, histiocytes, endothelial cells and fibroblasts. It is full of cellular immune bodies (the front lines of immunity), augmented by humoral antibodies, and it is this combination that stems the progress of bacterial action. For inflammation, repair and immunity are not

FIG. 2. Low power photomicrograph taken from a patient with carbuncle of the neck. Note how the infection descends from the hair follicle down the columna adiposa into the subcutaneous fat.

the same processes and as long as infection persists, the forces of repair may attempt the formation of healthy granulation tissue, but this is soon destroyed by the bacterial toxins. It is only after immunity has occurred and the invading organisms annihilated that healthy granulations are laid down, and repair by second intention occurs. This is the process that takes place in the simple boil as well as in the compound series of boils, the carbuncle. The method of spread is no doubt by tissue contiguity down between the fibrous septa of the subcutaneous tissue. The manner in which these localizing infections are handled has been carefully worked out. The ninth day after infection, there is a thrombosis of the lymphatics to the part, and colloids, such as india ink, injected

into the cavity, are no longer found in the neighboring lymph glands. After the sixth day this same cavity is impermeable to crystalloids. In carbuncle, although new tissue is invaded, this same process is set up with each new zone until finally the entire area is "walled-in." (Fig. 4.)

To help us arrive at the proper method of treatment, we studied 125 cases of severe carbuncle. This did not include an equal or even greater number of small carbuncles treated in our office or in the out-patient departments. It may be said in passing, however, that all of the latter were treated conservatively—the only surgery done was without anesthesia and consisted in connecting sinuses by incision and lifting out sloughs. (Fig. 5.) There were no deaths in this group.

Of the severe carbuncles eighty-three were in males and forty-two in females. Most occurred on the back of the neck (Chart 1) in both men and women, but

Chart 1
Anatomic Area Involved

	Males		Females		Total	
	No.	Per Cent	No.	Per Cent	No.	Per Cent
Neck	50	60.2	19	45.2	69	55.2
Extremities	15	18.0	10	21.4	25	20.0
Body	10	12.0	7	16.6	17	13.6
Face	5	6.0	5	11.9	10	8.0
Scalp	3	3.6	1	2.3	4	3.2

carbuncle occurred twice as commonly on the face of women, whereas, it was more common on the scalp of men. The face is a dangerous place, for four of the nine deaths occurred in facial carbuncle. The ages varied from 4 years to 80 years with the average age 48.3 years. Contrary to popular opinion, most patients (69 per cent) had no general associated disease, but of those who did diabetes was most common. (Chart II.) Particularly is this true of females, 76 per cent of whom were normal. (Is this due to picking and squeezing of pimples?) However, when carbuncle does occur in the debilitated it is apt to be more serious.

The type treatment studied may be

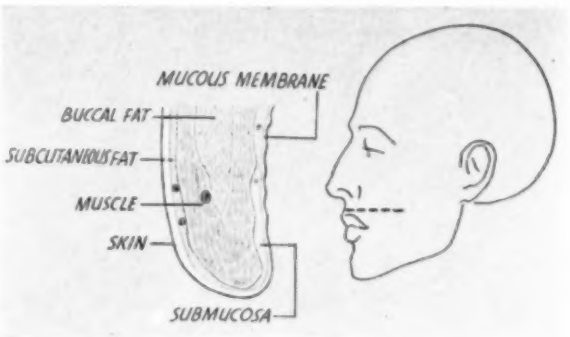

Fig. 3. Diagram of cross section of the cheek. The skin lies on a thin layer of subcutaneous fat which in turn is attached to the muscles of expression without intervening fascia. Small veins which anastomose freely in this area may easily become the seat of thrombophlebitis and cause an ascending infection via the superior ophthalmic vein (which is devoid of valves) into the cavernous sinus. The diagram on the right indicates the area from which the section was cut.

divided into: (1) excisions, by which is meant the complete extirpation of the lesion; (2) incision with or without removal

Chart II
Associated Diseases

	Male, Per Cent	Female, Per Cent
None	67.4	76.1
Diabetes	18	14.2
Miscellaneous*	4.6	9.7

* Miscellaneous includes: nephritis, multiple fractures, otitis media, pneumonia, erysipelas, syphilis, carcinoma of the breast, tuberculosis, severe burn, thyrotoxicosis, atrophic arthritis, prostatic hypertrophy, cerebral hemorrhage and pyemia.

of necrotic tissue; and (3) conservative treatment which includes *x*-ray, serum injection, ultra-violet ray, magnesium sulphate packs, various antiseptics, etc. Conservative treatment was used in 20 per cent of the cases and half of these had serious associated conditions. (Chart III.) Incision was used in thirty-two patient (26 per cent) and of these fifteen (or 46.8 per cent) had associated conditions. Excision was em-

ployed n sixty-seven patients (54 per cent); of these ten (14.9 per cent) had associated conditions. It is readily seen that conservative treatment and incision were the treatment of choice in those most seriously ill.

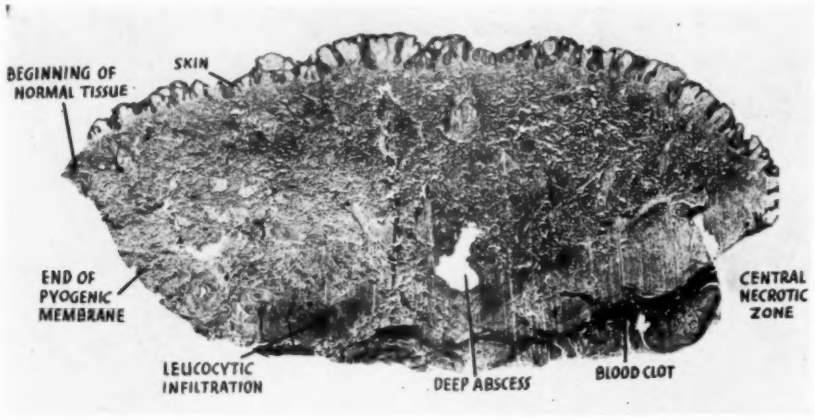

FIG. 4. Low power photomicrograph taken from a patient with carbuncle of the neck. This section extends from the center of the carbuncle to the outer edge. Note the wide area of leucocytic infiltration. The epidermis is viable.

CHART III
METHOD OF TREATMENT

	Total		With Associated Conditions		Without	
	No.	Per Cent	No.	Per Cent	No.	Per Cent
Conservative....	26	20	13	50	13	50
Incision.....	32	26	15	46.8	17	53.1
Excision.....	67	54	10	14.9	57	85

However, when we look at Chart IV, the mortality figures are indeed instructive. There were nine deaths. Eight of the nine (or 88.8 per cent) occurred in patients with severe illness. Six were diabetics, one had a cavernous sinus thrombosis and one had erysipelas and pneumonia. This chart further reveals that the highest death rate occurred when conservative treatment was used. This is misleading because these patients were thought to be too sick for any form of surgical treatment. On the other hand, the percentage of seriously sick treated by incision is almost as great, and yet only one death occurred.

The indications for treatment must be obvious from the above discussion. They may be dogmatically stated as follows: first, wait for localization; second, drain as adequately as possible; third, remove foreign bodies, which, in carbuncle, are the necrotic tissue; fourth, obliterate dead space by allowing granulations to form from the "bottom up"; fifth, supply rest to the part; and sixth, treat the individual as a whole, as in diabetes, etc. These general rules may be applied to any abscess, but in carbuncle several important facts must be further discussed.

CHART IV
TREATMENT AND MORTALITY

Treatment	No.	Per Cent	Mortality in Those without Associated Conditions		Mortality in Those with Associated Conditions		General Mortality	
			No.	Per Cent	No.	Per Cent	No.	Per Cent
Conservative.	26	20	0	0	5	19	5	4
Incision.....	32	26	0	0	1	3	1	0.8
Excision.....	67	54	1	1.5	2	3	3	2.4
Total cases.	125	..	2	1.1	8	21	9	7.2

Anyone who has made a study of this lesion will agree with the first fundamental law in the treatment; namely, wait for

localization. This implies the establishment of local immunity and any form of surgical treatment prior to this simply defeats all the magnificent efforts of nature and causes the infection to spread.

Drainage is also necessary, but the best method of obtaining this, we believe, depends upon two very important factors. The first of these is the location of the lesion. From the standpoint of natural or surgical drainage there are two kinds of carbuncle—facial or otherwise. If it is the former, surgical drainage is contraindicated. This agrees with the advice of Mitchiner and others.[4] Deep abscesses are not present, sloughs are relatively superficial, and the extreme danger of a spreading thrombophlebitis up the angular vein into the superior ophthalmic vein (which is devoid of valves) into the cavernous sinus, makes natural drainage (coupled with the slight help described below) the treatment of choice. The bad cosmetic effect of surgical intervention is an added important objection.[9] The second factor is the general condition of the patient. If there is severe diabetes present, for example, natural drainage or conservative management is advisable, together with specific care of the diabetes. Certainly these patients stand anesthesia poorly, and any surgery may cause a fatal thrombus or embolus or may stir up a bacteremia or pyemia of fatal import. As was previously pointed out, eight of the nine deaths occurred in patients with diabetes or other severe illness and seven of these patients died of general bacteremia. A study of Chart IV might seem to contraindicate this advice at first sight. However, it should be remembered that of the twenty-six cases treated conservatively, Chart III shows that 50 per cent were patients with severe systemic disease.

The term conservative is variously interpreted by many surgeons. Such measures as hot hypertonic packs, *x*-ray,[6] Bier's[7] suction, $MgSO_4$ and glycerine, injections of serum about the carbuncle, diathermy, various antiseptics, ultra-violet ray, collodion treatment[8] all have their strong advocates. However, we use the term to mean first rest in bed, with ample sedation to relieve pain, careful attention to fluids, food and elimination, and attention to diabetes if present. Locally, dry or moist heat for the comfort of the patient may be used, but always as little meddling as possible. As the skin becomes necrotic and multiple sinuses develop, their apertures may be connected painlessly in separate stages by incision without anesthesia, and loose sloughs may be lifted out. (Fig. 5.) In several cases *x*-ray has been used and we believe with some help.

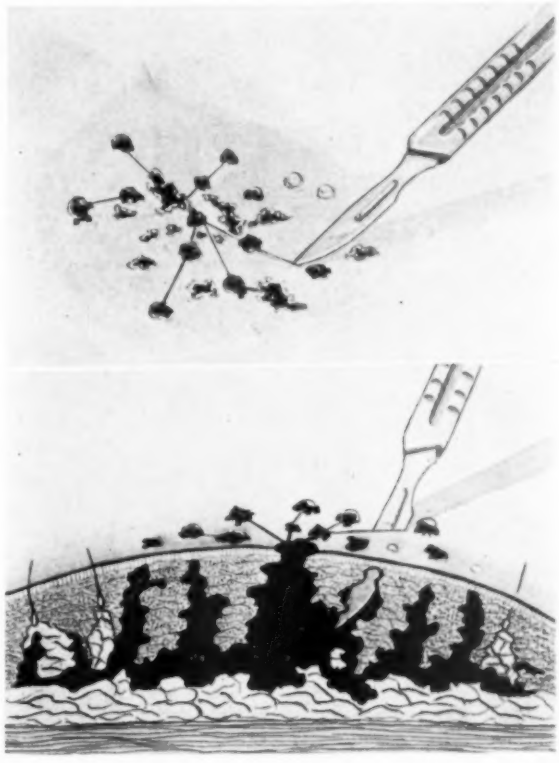

Fig. 5. Method of securing drainage in patients with carbuncle of face or with severe systemic disease. The draining sinuses are connected by incisions as shown. This is done in stages after localization. By this method anesthesia is unnccessary and ample drainage is provided. Sloughs are removed as soon as they separate.

If the carbuncle is not facial and not in a severely sick patient, surgical drainage by excision or incision may be used. Mitchiner,[4] Love,[3] and many others prefer excision. They show less mortality and greater freedom from recurrence, shortening of time and less pain. Others prefer incision with undercutting.[2] Our studies reveal that

either method is safe in this group. We believe that excision is safe because of the extremely wide "pyogenic membrane" in carbuncle and that even in "wide" excision, so-called, this wall is rarely transcended. Should the excised area go beyond this zone, the infection may invade adjacent tissues and the end result will be a huge raw area, with possible development of septicemia. (Chart IV.)

A B

FIG. 6. A, left half of carbuncle "excised," right half "incised" according to the method described in the text. B, two weeks later.

In an effort to test the efficacy of the two methods, a large carbuncle was treated in both ways simultaneously. (Fig. 6.) Half was excised, staying within the inflammatory zone, the other half incised and the flaps undercut. It will be seen that the flaps remained viable and were really pedicle flap grafts causing this side to heal in a much shorter time, although the excised half healed satisfactorily later. We have repeated this experiment in three other cases with the same result. Sometimes a pedicle undergoes necrosis; should this occur it can be removed without anesthesia.

The secret of successful incision is based upon undercutting. This is necessary if the many small abscess cavities are to be evacuated. Following this the flaps are lifted and sterile vaseline gauze is inserted under them. After three or four days it is removed, and irrigations with normal salt are given every two or three days. In our experience there is little difference between the use of antiseptics and normal saline. This agrees with the recent work of Smelo.[10] Incision conserves tissue[2] whereas the undercutting gives adequate drainage. It is easily and quickly done with minimal anesthesia and minimal trauma. On the extremities where tendons or nerves may be injured it is the treatment of choice.[5] Our studies show that the general mortality with this treatment is 0.8 per cent as opposed to 2.4 per cent for excision. Because of the preservation of skin attached by a broad base, living grafts are preserved and healing is facilitated. In the University Hospitals, patients treated by conservative management required the longest period of hospitalization. Many of the patients who were treated by excision of the carbuncle required subsequent skin grafts. Those treated by incision remain the shortest length of time.

The removal of cellular débris, which is our third rule, is accomplished easily in all methods of treatment. In conservative

cases, the sloughs are removed as they separate without anesthesia, as previously described. With surgical methods, necrotic tissue is removed at the same time that drainage is provided. The fourth requirement is satisfied by judicious observation and, when incision is used, by a short period of packing followed by occasional irrigations. Rest to the part in severe carbuncle usually implies rest in bed and this varies with the time necessary for localization and the type of treatment required. Patients with severe systemic disease obviously require intensive treatment, for immunity and repair depend ultimately upon the general condition of the patient.

CONCLUSIONS

1. A study of the microscopic anatomy of the skin on the back of the neck and on the face clearly explains the behavior of this lesion and definitely establishes carbuncle of the face as a distinct entity.

2. A statistical survey of carbuncle reveals the following information concerning occurrence:

   (a) Most carbuncles occur on the neck in both sexes, but are more frequent on the face in women than in men.

   (b) Most carbuncles occur in patients without debilitating disease; this is more noticeable in women than men.

   (c) Both of the above observations lead to the conclusion that "picking" of skin infections is an important causative factor.

   (d) Of all associated diseases, diabetes is most frequent.

   (e) When the carbuncle occurs in patients with debilitating disease or on the face, it is more serious.

3. A statistical study of treatment and mortality rates leads to the following deductions:

   (a) Carbuncle of the face is the most serious, causing 45 per cent of the deaths encountered. Reasons are given for treating such lesions conservatively. The general mortality in facial carbuncle was 40 per cent.

   (b) Carbuncle elsewhere on the body, associated with severe debilitating disease, must also be treated conservatively. Five of the nine deaths occurred in this group. The general mortality was 18 per cent.

   (c) Carbuncle not on the face and not associated with severe disease should be treated by surgical intervention. This may be by excision or incision. The general mortality in this group was 1 per cent.

4. Statistical and experimental observations point to incision with undercutting as the operation of choice because:

   (a) The mortality is much less (.8 per cent as against 2.4 per cent).

   (b) There is quicker healing due to the preservation of viable skin flaps.

   (c) There is no necessity for subsequent skin grafting.

   (d) The period of hospitalization is shortened.

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THE PHYSIOLOGIC BASIS FOR LIGATION OF THE GREAT SAPHENOUS VEIN IN THE TREATMENT OF VARICOSE VEINS*

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MANY additional surgical procedures, some of them very elaborate, have been proposed for the correction of varicose veins since Trendelenburg's original suggestion in 1890[1] that they be treated by ligation of the saphenous vein. The Trendelenburg operation, however, has stood the test of time, and properly so, for there is no simpler and more direct mode of attack upon this very common and highly disabling condition. Trendelenburg proposed that the great saphenous vein be ligated at the junction of the middle and lower third of the thigh. Homans[2] in 1916 and Edwards[2] in 1936 proposed, instead of ligation at this point, ligation of the vein and all its terminal branches at the saphenofemoral junction, and this is the single important modification of Trendelenburg's original procedure which has so far been suggested. Today, the standard method of treatment for varicose veins associated with incompetency of the valves of the saphenous vein is high ligation of that vein, followed by the injection of some sclerosing substance.

Trendelenburg's conception of the altered physiology present in varicose veins has been little changed by the passage of years. As he pointed out in his original paper, the essential pathologic change is a reversal of the normal blood flow. The blood flows downward in the varicosity through the communicating vessels into the deeper circulation instead of toward the heart, as normally. He believed, and his idea has been very generally accepted, that ligation of the saphenous vein corrected the reversal of the blood flow and also corrected the back pressure presumably associated with it. But this new concept has remained merely a concept. It has never been established, nor, so far as we know, has any study ever been undertaken to determine exactly what circulatory changes occur after ligation of the saphenous vein, or to demonstrate the supposed alterations in venous pressure which this procedure achieves. Such a study we have ourselves undertaken on twenty-one patients, all of whom had marked varicosities of the leg; all presented an adequate deep venous return and all presented positive Trendelenburg tests.

The first part of the study was carried out upon eleven patients and was devoted to a determination of the venous pressure before and after ligation of the saphenous vein. The examinations were made while the patients were in the standing position, by means of an 18 gauge needle attached to a U-tube mercury manometer. The venous pressures of the popliteal vein and of the varicosities at the same level and at the ankle joint were determined and recorded before the saphenous vein was ligated, and immediately afterward. As Table 1 shows, the pressure in the popliteal vein was always lower than the pressure in the varicosities at the same level both before and after the saphenous vein was ligated, with the exception of one case, in which the pressure was equal in the popliteal vein and in the varicosities at the same level. The pressure changes varied, it is true, sometimes rising and sometimes falling, but there was always a clear tendency toward rapid readjustment. It may fairly be concluded, therefore, that the concept so long accepted is erroneous,

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and that pressure changes play no important part in such results as are achieved by ligation of the saphenous vein.

TABLE I

Comparison of pressure in deep veins & superficial varicosities before and after ligation of the saphenous vein

	Before ligation of saphenous vein			After ligation of saphenous vein		
Case	Popliteal Vein	Varicose Vein at knee	Ankle	Popliteal Vein	Varicose Vein at knee	Ankle
1	46 mm Hg.	56 mm Hg.	70 mm Hg.	40 mm Hg.	48 mm Hg.	86 mm Hg.
2	50 mm Hg.	60 mm Hg.	80 mm Hg.	42 mm Hg.	58 mm Hg.	88 mm Hg.
3	58 mm Hg.	62 mm Hg.	86 mm Hg.	58 mm Hg.	60 mm Hg.	84 mm Hg.
4	58 mm Hg.	62 mm Hg.	80 mm Hg.	56 mm Hg.	58 mm Hg.	
5	60 mm Hg.	60 mm Hg.		56 mm Hg.	70 mm Hg.	
6	46 mm Hg.	48 mm Hg.		40 mm Hg.	44 mm Hg.	
7		54 mm Hg.			56 mm Hg.	
8		66 mm Hg.			66 mm Hg.	
9		40 mm Hg.			54 mm Hg.	
10		76 mm Hg.			54 mm Hg.	
11		40 mm Hg.			56 mm Hg.	

The second part of the study was carried out upon ten patients, and was devoted to a determination of the direction of the blood flow in the varicosities before and after ligation of the saphenous vein, as well as to the relative rate of emptying time in them before and after ligation. The reversal of the blood flow, which is the fundamental pathologic change in varicose veins, had been visually demonstrated by McPheeters and others, but we are aware of no attempt to determine what changes in the direction and rate of flow occur after ligation.

Our studies were carried out with stabilized thorium dioxide, an agent which we have been using for the past four years for the visualization of the peripheral blood vessels, and which we have found eminently satisfactory. When properly injected it does not cause pain or produce avascular damage. It is slightly heavier than blood and so is readily miscible with it, but it is not so heavy that it gravitates downward from its mere weight. Figure 1C demonstrates this point very clearly; the solution was injected into the popliteal vein while the patient was standing, yet in spite of the upright position it is ascending the venous channel, as the venous flow is normally upward in this location.

Our technique in this study was very simple. The patient stood upright on the table against the fluoroscopic screen. Four c.c. of stabilized thorium dioxide was injected into the varicosities about 3 inches above the knee, and then, while the patient remained absolutely immobile, the downward direction of the flow was noted. (Fig. 1A.) Repeated observations were made until the solution had completely disappeared from the varicosities. It was noted that the opaque medium always

descended rapidly in the varicosities and disappeared into the communicating and deep veins, the time required for its final disappearance varying from one and a half to seven minutes.

TABLE II

Rate of flow of opaque medium from varicosities before and after ligation of saphenous vein

	4cc before ligation		4cc after ligation	
Case 1	Disappeared-	3 min.	Still present	15 min.
Case 2	Disappeared	1½ min.	Still present	8 min.
Case 3	Disappeared	4½ min.	Still present	8 min.
Case 4	Disappeared	5 min.	Still present	12 min.
Case 5	Disappeared	3 min.	Trace	7½ min.
Case 6	Disappeared	1½ min.	Trace	10 min.
Case 7	Trace	7 min.	Heavy Trace	15 min.
Case 8	Disappeared	4 min.	Still present	12 min.
Case 9	Faint Trace	4 min.	Heavy Trace	8 min.
Case 10	Disappeared	4 min.	Disappeared	4 min.

Similar fluoroscopic studies were repeated after the ligation of the saphenous vein at the saphenofemoral junction, the same amount (4 c.c.) of the stabilized thorium dioxide solution being used for the second injection. Immediately after the injection the opaque solution whirled about the point of injection; then part of it slowly ascended toward the ligated end of the vein and there remained, while part of it slowly descended. As the middle and lower part of the leg was reached, the downward flow became more and more rapid until finally the solution disappeared into the deeper veins. (Fig. 1B.) In other

A B C D

FIG. 1. A, Reverse flow of opaque medium in superficial varicosities before ligation. B, opaque medium descending in varicosities after ligation of the saphenous vein. C, upward flow of opaque medium after injection into the popliteal vein. D, control of the backward flow with use of tourniquet.

words, after ligations of the saphenous vein the blood whirled about the point of injection of the opaque substance (3 inches above the knee); near the ligated portion of the vein it remained stationary, while below the knee it descended as before ligation, but at a much slower rate. Marked slowing was noted in all but one of the cases studied. As Table II shows, the time of the disappearance of the thorium dioxide solution varied considerably. The absolute time is not recorded in all cases because the slowing of the circulation was so marked that too many *x*-ray exposures would have been required to obtain the information.

After we had satisfied ourselves that the rate of blood flow through the varicosities had been markedly slowed after ligation of the saphenous vein, the patient was requested to move his foot and leg as if he were walking. Immediately afterward the opaque solution disappeared, the muscular action apparently being sufficient to produce rapid emptying of the varicosities and rapid descent of the solution at the level of the knee and in the lower leg. In some cases the solution in the upper segment of the vein near the ligated end of the varicosities also descended; in other cases it disappeared by way of the collateral vessels.

Our observations have shown us that before ligation of the saphenous vein the circulation in the varicosities is rapidly downward, the speed of the downward flow depending upon two factors: the volume of blood entering the varicosities and the height of the blood column. When all the valves of the saphenous vein are incompetent, as they were in this selected group of patients, a long column of blood is thus able to flow rapidly through the varicosities and finally backward through the communicating branches and into the deep circulation. (Fig. 2A.) This situation is entirely altered after ligation of the saphenous vein. The weight of the column of blood is removed and the varicosities fill, as do normal vessels, from the superficial tributaries and perhaps from the upper communicating branches, until the pressure in them again reaches a constant

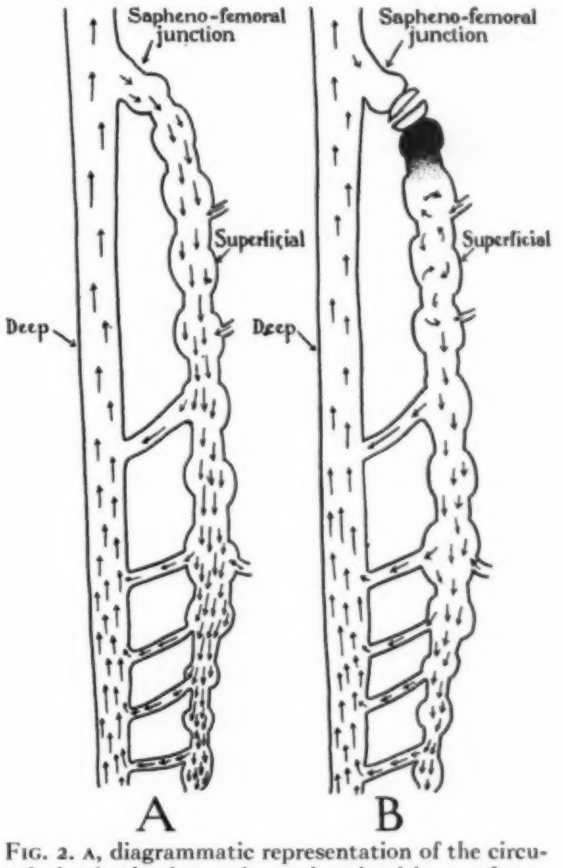

Fig. 2. A, diagrammatic representation of the circulation in the deep veins and varicosities. B, alteration of the circulation after ligation of the saphenous vein. Direction of arrow points in direction of blood flow. The number of arrows indicates rapidity of flow.

level. The pressure in the varicosities remains higher than the deep venous pressure while the patient stands erect, and the blood from the deep venous channels cannot flow through the lower communicating branches into the superficial system. The blood therefore enters the varicosities in smaller amounts from the tributaries, and perhaps from the upper communicating branches, and upward flow is prevented by occlusion of the vein. As the lower leg is reached, the flow is downward and the rate much slower than it was before ligation. (Fig. 2B.)

In a few instances (4 per cent of 261 cases, according to Cooper[5]) the varicosities undergo spontaneous thrombosis after liga-

tion of the saphenous vein, and no further treatment is required. Usually, however, the introduction of some sclerosing substance is also necessary. The rationale of the combined treatment is clear. The simple introduction of a sclerosing agent, which damages the intima of the vessels, is not usually sufficient for the production of thrombosis, for the flow of blood through the varicosities is so rapid that either no clot at all is formed, or the one that is formed does not completely fill the lumen of the vessels and is likely to be rapidly washed away. When to the damage of the intima, however, is added the slowing of the rate of blood flow produced by ligation of the saphenous vein, the circumstances are ideal for the formation of a firm, occluding clot, and a good result can usually be expected.

As the outcome of our studies, we have devised a method of controlling the circulation in the varicosities prior to the injection of the sclerosing agent. (Fig. 3.) The saphenous vein and its immediate tributaries are ligated at the saphenofemoral junction, after which, while the patient lies prone, with the extremity elevated, an elastic bandage is applied from the middle of the foot to the tuberosity of the tibia. (Fig. 1B.) Then, while the patient stands, 5 c.c. of sodium morrhuate solution (5 per cent) is injected into the saphenous vein just above the upper level of the bandage. The usual result is a firm clot in the upper segment of the vein. At weekly intervals the bandage is lowered 4 to 6 inches and the injection is repeated. Three or four such treatments usually produce thrombosis of the entire vein. Small venous

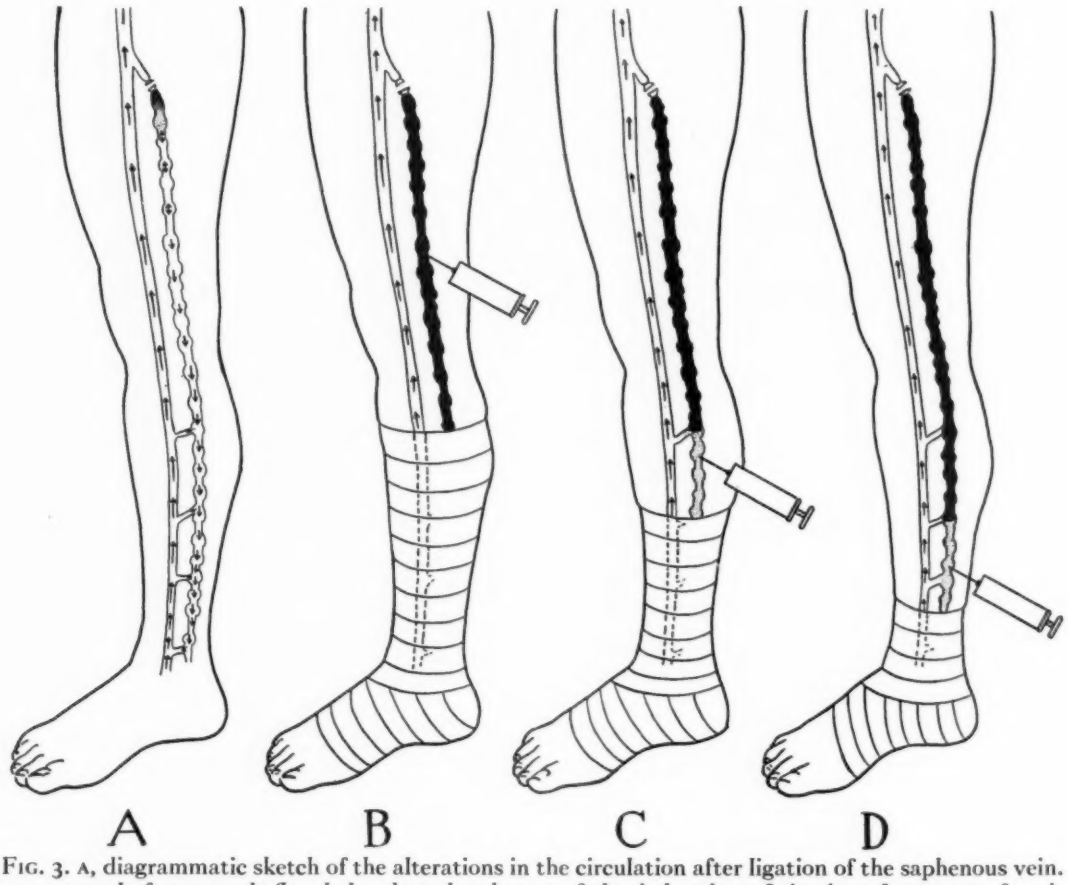

Fig. 3. A, diagrammatic sketch of the alterations in the circulation after ligation of the saphenous vein. B, control of retrograde flow below knee by the use of elastic bandage. Injection of segment of varicosity above bandage. C, lowering of bandage and injection of varicosity. D, further lowering of bandage and injection of varicosity.

pockets are injected later and separately, as the need arises.

This is now our routine treatment for varicosities associated with incompetency of the valves of the saphenous vein. We have amply demonstrated its value as an adjunct to high ligation of the vein, and we have also found it a very satisfactory method for cases in which this vein is not involved. We make no claim to priority, though we have not seen the method described elsewhere, but we do recommend it without reservation to surgeons who are called upon, as we are, to handle a large number of patients in a clinic with limited facilities of space and equipment.

SUMMARY

1. By a series of tests, we have demonstrated the physiologic effect of high ligation of the saphenous vein for the correction of varicosities:

(*a*) The rate of blood flow in the varicosities is slowed.

(*b*) The blood flow ceases entirely in the upper segment of the ligated vein.

(*c*) At the point of injection (just above the level of the knee) the blood current whirls slowly, the flow being both upward and downward.

(*d*) Below the knee the flow is again downward and the rate is much slower than before ligation of the vein.

2. Other studies, by which we have shown that there is a rapid readjustment of the venous pressure in the varicosities, seem to indicate that pressure changes play no part in the beneficial results obtained by ligation of the saphenous vein.

3. By the use of elastic bandages to control the downward flow of blood, the current can be completely stopped. An ideal set of circumstances is thus established for the production of rapid, firm thrombosis following the injection of a sclerosing substance. The method is applicable to cases in which the saphenous vein is not involved as well as to those in which high ligation is necessary. No claim to priority is made for this procedure.

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THE RATIONALE OF THE SURGICAL TECHNIQUE IN CARCINOMA OF THE RECTUM AND SIGMOID*

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MANY of the deaths from carcinoma are unnecessary and can be avoided by cooperation between the physician and the specialist. There is one thing that stands out above all others, namely, the routine digital examination. No physical examination is complete without it.

Cooperation between family physician and proctologist would lead to the identification, then the eradication of malignant disease in its early stages when a prospect of cure is almost a certainty. It would also abolish the regrettable practice of labeling cases inoperable when in fact they are for the most part operable in the hands of experts.

It is our propose to discuss only the treatment of well established cases of cancer of the lower bowel, and not the early lesions which may be eradicated by local removal. To that end let us consider the purpose of operation, which is to rehabilitate the patient, i.e., restore the individual to useful life. There must be no invalidism and no neurosis or the operation has not been a complete success, even though the disease may have been completely stamped out. Surgery offers the only means of attaining this result. Irradiation has as yet to prove its place in the treatment of carcinomata of the lower bowel, for although it cannot be denied that many individual cases, in the hands of experts, have been arrested temporarily, and some even appear to have been cured, these instances are too rare to permit consideration of this type of therapy at present.

Sir Charles Gordon-Watson is one of the few eminent surgeons to have thoroughly investigated radium therapy in cancer of the lower bowel. His experience has been a bitter disappointment to him. From March 1925 to the end of 1931 he had tried this form of therapy on 149 private cases. Since then he has only used it in nine cases. The cases in which he saw fit to use this method were those of the operable type in which surgery was resolutely refused, and in selected inoperable cases. He has also inserted radon seeds into the region of the retrorectal glands at the time of colostomy before excision. One of us had the opportunity, as one of his dressers, to see the sections of many of these tumors. In every case viable malignant cells were found shut in by dense fibrous tissue. Sir Charles himself feels that the main reason for the small percentage of cures with this type of therapy is the fact that it is almost impossible to deliver a sufficiently large dose to the tumor, due to the difficulties of access and the position of the rectum.

As regards *x*-ray therapy for these cases, Dr. W. Levitt, of St. Bartholomew's Hospital has said: "The treatment of carcinoma of the rectum with deep *x*-rays still remains unsatisfactory, and in spite of every effort to improve the technique, the results have shown little or no improvement during the past few years. . . . The failure of rectal growths to respond to *x*-ray treatment would appear to be due mainly to an inherent lack of radiosensitivity in the essential cell of the growth. That these growths *can* respond, however, to *x*-ray treatment when sufficient dosage is administered is suggested by the behavior of the glandular and isolated secondary deposits, . . . which are more

* Read before the American Proctologic Society, Atlantic City, June 6–9, 1937.

superficially placed than the primary growth, and are thus accessible to more intensive irradiation."

It seems needless to warn of the dangers of the many pseudo-scientific cures which are being popularized in the lay press. However, as we have recently encountered many men of eminence in non-surgical fields who have been led astray by the false promises these so-called cures hold forth, we urge the surgeon never to dismiss such matters with a shrug, but to explain carefully and patiently the falsity of all such claims. There is, of course, no place for diets or serums in the cure of established cancer. Many of these so-called cures not only fail to destroy the growth, but complicate the work of the surgeon who finally has to cope with the condition.

The operation for the eradication of cancer of the lower bowel must be carefully planned. The ideal surgery is that which eradicates the growth and accomplishes rehabilitation of the patient. The next best operation is that in which the diseased tissue is partially eradicated yet there is complete rehabilitation of the patient. The third type completely eradicates the neoplasm but only partially rehabilitates the patient. The fourth type is the palliative operation. Palliative surgery is only justified as a last resort to change the character of impending death.

The choice of operative technique will vary with three factors: (1) with the site and type of the growth; (2) with the individual patient, who must be considered both from the physical and the psychological standpoint; and (3) with the experience and skill of the operator.

Obviously, a growth low down in the rectum will demand a different technique from one high in the sigmoid. Also, the degree of fixation and infiltration will affect the type of surgery. The stoutness of a patient may necessitate different tactics from those applicable in a thin individual. The age and any concomitant pathology may also influence operative procedure. The psychology of the patient likewise will have a bearing on outlining surgery. Some people are so constituted that they would really prefer to die rather than to be left with an artificial anus. With these people one is justified in accepting a little extra risk, in order to leave them with a stoma as nearly resembling the original anus as possible. It is also important to place the stoma so that it may not interfere with the patient's occupation. We recall one completely successful case in which the stoma was so placed that the patient pressed against it continuously at his work of weaving. This became such an annoyance that we were compelled to operate again and change the position of the colostomy, whereupon the patient proceeded to resume his work with pleasure.

Only a surgeon with much experience in assisting at these operations should attempt to perform one himself. During the probationary period he will have undoubtedly discovered a facility for certain types of surgical procedure which will largely influence his choice of operation. We all realize that certain operations are easier for us, even though they may present more actual technical difficulties. It would be very unwise to ignore these considerations in planning operations.

The main purpose of an operation for carcinoma is, of course, complete eradication of the disease by whatever means necessary. To be able to plan such an operation successfully, one must fully appreciate the manner of spread of carcinomata. Cuthbert Dukes and his coworkers at St. Marks Hospital in London have sectioned all the specimens removed from the lower bowel (100) at that institution during the past seven years. These sections have proved conclusively that metastases in the rectum and rectosigmoid first occur in glands at the same level or immediately cephalad to the growth, and then follow the superior hemorrhoidal artery. They have also shown that metastases do not skip over any glands in one chain, but spread evenly and regularly, invading

each gland in turn within that area. They have proved also that the lateral spread from these growths does not occur until the main lymphatic channels are completely blocked, when a collateral lymphatic circulation becomes established and the carcinomatous cells are borne along this current. The paracolic glands lying in the mesenteric border of the pelvic colon were affected in only one case, and that a very late one.

This is a work of tremendous import and bears out fully our own clinical experience with over 1000 cases upon which we have operated. It permits one to discard entirely such radical and useless operations as that popularized by Miles. As can be seen from these findings, when the "Miles" operation is indicated for the removal of a growth, the lateral spread of the disease has already gone so far as to render futile any hope of cure. Since there is no lateral spread of metastasis until the main lymphatics are completely obstructed with growth, there is no necessity of removing large areas of tissue laterally. And since only one case in seven years was encountered at St. Marks Hospital in which paracolic glands were invaded, it seems useless to remove them routinely. If a case be encountered in which there is lateral spread of the growth and involvement of the paracolic glands, then and then only, we feel, is a surgeon justified in performing the "Miles" operation. Therefore one can plan more conservative operations with a lower operative mortality and with the same expectancy of cure.

With this added knowledge, we will now consider the suitable operations for eradication of carcinoma of the rectum and sigmoid. These are simple perineal resection and the combined perineo-abdominal operation, either with an abdominal or a perineal stoma. The two latter may be performed in one or more stages. We have always felt that the one-stage operation is preferable except in the presence of marked intestinal obstruction. We consider that nothing of sufficient importance is gained by multiple stages to warrant opening the abdomen twice and the second time having to deal with adhesions in their most troublesome state, i.e., when they are filled with small adventitious vessels which ooze throughout the operation. The chief advantages claimed for the multiple stage operation are that it lessens the shock to the patient and permits examination of the liver for metastases. We are not convinced that two or more major operations produce less shock than one, even though the single stage procedure be prolonged. The presence or absence of metastases in the liver does not alter our technique. Therefore, we can see no benefit resulting from a discovery of this condition beforehand.

The abdominal colostomy has always seemed a barbarous method and infinitely damaging to the psychology of the patient. Of course there are occasions when it cannot be avoided, but in most instances it is performed because the surgeon does not realize that a perineal stoma within a year, in people of normal mentality, is fully controllable. In our experience it takes no longer for a patient to learn to control a perineal than an abdominal colostomy. And even if it did take longer, would you not prefer to have some leakage per perineum to feces running down your abdomen? We find that patients do not suffer so much psychic trauma immediately post-operatively if the stoma is placed as near the original site of the anus as possible.

Simple perineal resection is, of course, the operation of choice when possible. In the hands of experts it has a mortality of under 5 per cent. In the light of Cuthbert Duke's work and our own clinical experience it offers just as good a prognosis as a more radical operation, provided the cases are carefully selected. Experience will enable the operator to use this technique upon an increasingly large percentage of cases, since by practice it becomes possible to remove more and more bowel from below.

We have devised a technique, which is reported elsewhere,* simplifying this operation. We have found that it is unnecessary to make any effort to approximate the bowel to the skin—it is sufficient to excise the bowel at the level of the reformed peritoneal floor. We have also discarded all attempts to close the gaping perineal wound. We merely dress it with gauze soaked in a 10 per cent solution of tannic acid and alcohol. This forms a film which is strong enough to prevent saprophitic infection, but is not dense enough to permit the growth of virulent organisms beneath it. Since we have adopted this technique, the post-operative care of these patients has been greatly simplified. There are no longer prolonged irrigations. Simple lavage to clear away fecal matter is sufficient. There is no infection, and no formation of pus pockets; there is no danger of secondary hemorrhage, the patients are comfortable, afebrile, and are usually out of bed on the seventh to the tenth day. Thus not only is the operative technique simplified, but the operation time is shortened and the period of hospitalization is greatly lessened. We have found that the cosmetic result of this operation compares favorably with that of any we have seen where attempts at plastic repair were made.

* Am. J. Surg., 36: 618, 1937.

SUMMARY

1. Carcinoma of the lower bowel costs 35,000 deaths a year in the United States of America.

2. The main cause is late or faulty diagnosis. This is unforgivable, since 50 per cent of these tumors are within reach of the examining finger; therefore, a digital examination must be done as a routine.

3. The next greatest cause is improper treatment.

4. The abdomino-perineal operation, popularized by Miles, is unnecessary.

5. Metastatic spread is along the course of the superior haemorrhoidal artery and lateral or retrograde spread occurs only with the establishment of a collateral lymphatic circulation.

6. The perineal stoma is much to be preferred psychologically and functionally.

7. Reference is made to a simplification of the operation of perineal excision of the rectum for carcinoma.

8. The advantages of the use of 10 per cent tannic acid in alcohol in large granulating wounds is explained.

ELECTROSURGERY IN PROCTOLOGY

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THE proper status of electrosurgical measures in the practice of proctology has not yet been definitely established. There has been an erroneous impression that electrosurgery has simplified rectal surgery. The availability of a diathermy machine would seem to qualify anyone with the temerity to perform proctologic surgery, although even the good general surgeon is not too well groomed in this field. Furthermore there is an unwarranted idea that any rectal operative procedure, particularly in the case of hemorrhoids, may be done by electrical methods, a practice which deserves particular condemnation. There are certain operative procedures which are undoubtedly better performed by electrosurgical methods, others in which they are contraindicated, and again others in which they are indispensable.

It would seem advisable at this time to attempt properly to evaluate the advantages, disadvantages and indications and contra-indications of electrosurgery in the modern practice of proctology, and to emphasize fundamental electrosurgical effects of the several currents on the anorectal tissues.

ELECTROSURGICAL CURRENTS

It is not within the scope of this short article to deal with the intricacies and fundamentals of electrophysics. Although quite desirable, such technical knowledge is available elsewhere and is not absolutely necessary to the proper and successful use of the several electrical modalities offered by the modern tube or a spark gap apparatus, whether used for medical or surgical purposes.

It is, however, essential that the operating proctologist be thoroughly familiar with his own particular machine in its various settings and that he have a well defined idea concerning the destructive or electrosurgical effects of the different currents. This applies particularly to their use in and around the anus and rectum where the danger of infection, excessive scarring and sloughing with resultant hemorrhage is not sufficiently appreciated. It should be noted that in the same operative procedure several different tissues whose specific resistance vary to a considerable degree are subjected to the same current intensity. The type of current, the method of its application, and the density or vascularity of the tissues are essentially the factors which determine the depth of destruction, and this to the proctologist is paramount.

Common usage has restricted the term electrosurgery (surgical diathermy, endothermy, electrotomy, etc.) to the surgical application of the high frequency currents of either damped or undamped oscillations. The type of current primarily determines the character of the electrosurgical effects on the various tissues and on this basis they have been classified as: (1) electrodesiccation; (2) electrocoagulation; and (3) electrocutting. The electric cautery, the loop cautery knife (Downes cautery), and galvanism are also currents used for their surgical effects, but since the tissue response is somewhat different, it seems advisable for the sake of clarity to discuss them separately.

Electrocoagulation and cutting may be used to advantage in the same operative procedure; the modern apparatus affords separate terminals for these currents, the

intensity and volume of which are controllable within wide limits, to produce almost any desired electrosurgical effect.

ELECTRODESICCATION

The destructive action of the high frequency current from a single terminal was first described by Oudin, and the current is referred to as the Oudin or monoterminal current. It is one of high voltage and low amperage with damped oscillations. In contrast to the current used for coagulation, it produces primarily a dehydrating action on the blood vessels with shrinking and drying of the tissue cells. This is accompanied by a very mild inflammatory response and but little outlying cell degeneration and necrosis. This accounts for the limited superficial and softer scarring resulting from its action, in contrast to the deep, dense and contracting scars produced by coagulation and cautery. Preservation of the normal contractility and resiliency of the anal canal has not been accorded the consideration it deserves. The superficial destructive action of the Oudin current is entirely under control since its action is from without inward in contrast to bipolar or biterminal methods, in which the extent of destruction action is not always predictable within safe limits.

The Oudin current is, therefore, decidedly the preferable one to use in the removal of papillae, polypi, papillomata and other benign tumors of the anal canal. We are convinced that it is the only current to use in hemorrhoidectomy, if electrical methods must be used in this procedure. The author's special technique of using the Oudin current in the removal of hemorrhoids is described elsewhere.

Hypertrophic Anal Papillae. These are readily destroyed by exposing them directly after the sphincters have been anesthetized with either novocaine or anucaine. The latter gives more relaxation and better exposure, and it diminishes after-pain. The papillae are desiccated flush with the adjacent mucosa. Accompanying deep crypts should be excised and the resulting small wound may be desiccated to control oozing, which is usually slight. If exposure cannot be secured directly, an anoscope may be inserted and the papillae and crypts removed as described.

TABLE I

ELECTROSURGICAL METHODS (MODIFIED FROM KOVACS)

Form		Technique	Effects
Electro-desiccation.	Monoterminal	Active electrode-pin head connected to high voltage terminal (Oudin), in contact with part. Patient may be grounded from a large dispersive dialectric electrode for potentiation of current.	Dehydration and shrinkage followed by superficial sloughing. The preferable current to be used in the anal canal.
Electro-coagulation.	Biterminal	Active, any desired shape electrode connected to one terminal; large dispersive electrode to other terminal. A biterminal needle or clamp connected to indicated terminals of machine.	Coagulation and massive hyalinization of tissue. Deep destruction and deep sloughing. Good hemostasis. Coagulation more or less limited to tissue between needle points or jaws of clamp.
Electro-section, cutting or electrotomy, radio knife etc.	Biterminal	Cutting electrode, needle point or blade connected to one terminal, large dispersive electrode to other terminal.	Rapid dissection and separation of tissue with high intensity of current. Seals capillaries slight eschar and slough. Lower intensity of currents deeper eschar- (coagulotomy). The preferable current for electric snare techniques.
Galvanism (electrolysis).	Biterminal	Active electrodes, long 6–8 inch steel needles insulated ⅛ to ½ inch from tip, usually attached to negative pole of galvanic generator. Large dispersive electrode to opposite pole.	Either pole has caustic action (electrochemical cauterization) negative pole causes tissue liquefaction, positive a dry necrosis. Used for uncomplicated internal hemorrhoids. A poor and uncertain method which should be discarded.

Prolapse. In the so-called first degree prolapse, in which the mucous membrane is erroneously thought to be involved, desiccation has been used with considerable success, particularly by Bensaude of Paris. The cases should be carefully selected. The confusion in the terminology

of prolapse has led in some instances to undesirable and inadequate methods.

The technique consists in drawing out the rectal wall with Allis clamps and making longitudinal lines of desiccation about 1 inch apart. The object is to produce an inflammatory reaction in the submucosa and muscularis with a subsequent deposition of fibrous tissue. After the prolapse has been replaced, the rectum should be packed with gauze surrounding a fairly large sized rubber tube, for forty-eight hours. Subsequent straining at stool is avoided by proper catharsis, tube irrigations and having the patient defecate in the supine position for several weeks. The method is quite satisfactory in children.

Coagulation has been recommended in place of desiccation. However, if the former is used, it is quite essential that the operator know the exact destructive action and depth of the current used. Considerable sloughing with secondary hemorrhage and perforation may occur.

ELECTROCOAGULATION

Electrocoagulation employs a current of higher amperage and it results in a rapid and complete destruction of tissue, which is more profound in the center and becomes irregularly less toward the periphery (coagulation necrosis). Recent studies by Keysee and Niede have shown that the necrosis following coagulation is always uneven and varies with the resistance of the different tissues. The resulting slough and tissue destruction is therefore unpredictable.

That the degree and extent of the heat generated in the tissues by high frequency currents cannot be estimated within safe limits, is particularly well emphasized by Caulk and Patton[5] who state: "It was shown that with high frequency currents, which are usually employed, whether the gap or tube machine, definite elevations in temperature were produced in the mediums or tissues away from the point of burning, and the degree of heat varied according to the distance, the current value, the time of application, and depended not on conduction, but on production in tissue as it came through between the two electrodes at the point of burning."

Histologic studies by the same authors showed the following definite zones of destruction following the application of the high frequency currents:

1. Coagulation necrosis.
2. A zone of fragmentation in which the cells lost their staining qualities and in many instances were broken up. This zone showed copious hemorrhage.
3. A more or less normal zone but in which the cells showed desquamation and evidence of shrinkage.

"It is the deep heat effect that is evidently responsible for many of the late sloughs and erosion of vessels which creates the tendency to secondary hemorrhage and sepsis."

It seems obvious that electrocoagulation in and around the anorectal region, particularly in the anal canal, may be productive of great harm, and with the exception of premalignant, definitely malignant, and granulomatous lesions, its use is unnecessary and undesirable. It should never be used for hemorrhoids of any kind, its many advocates to the contrary notwithstanding. Snare methods in the removal of hemorrhoids with this current deserve particular condemnation. In the best hands, the depth and extent of destruction is not at all predictable within safe limits.

The biterminal use of clamps, electrodes and needles has been devised to overcome these objections. These instruments, however, fail to do so, and there are simpler, safer, and less cumbersome methods of securing the same desired end result.

Electrocoagulation may be used to advantage in the following proctologic conditions. It has, however, a wider range of usefulness in combination with the cutting current which will be discussed subsequently.

Fistula. For the destruction of suspiciously premalignant or already malignant excrescences in the openings or tracks of

chronic fistulae, electrocoagulation may prove useful. This applies also to the occasional case of fissure with old chronic hypertrophic edges in which surgery is contraindicated or refused.

Following the incision of fistulae by the cutting current or knife, the common practice of swabbing the wound with pure phenol, with the idea of destroying the remaining tracks or small offshoots, could be advantageously replaced by the more certain and controllable application of the coagulating current. In this instance, the depth of destruction in the tissues external or lateral to the sphincters may be an added advantage. The current should not be applied to the musculature of the anal canal.

The electric cautery may be used for the same purpose; in fact, many proctologists prefer the cautery in fistula incision, particularly in the definitely established tuberculous variety. Where tracks are cleanly and totally excised, there is no indication for further destruction of tissue by any means, electrical or otherwise.

Condylomata. Anal Warts. Although electrocoagulation has been used for the destruction of these excrescences, the actual cautery in our experience has been more effective. Thorough eradication is essential for these tumors, and particularly so for those situated in the anal canal or lower rectum, because the secretion and moisture from those untreated or overlooked may lead to prompt recurrence. They are self-inoculable. Luetic condylomata require additional systemic treatment which should be under way before local removal is undertaken. *X*-ray is at times of great benefit, but should be used with caution.

Adenoma, "Polypi," Papilloma, Villous Tumor. Under this heading are included a number of so-called benign tumors, which, however, possess all the anlages for ultimate malignancy, particularly in adults. On this account, they are of particular interest and importance and their prompt and complete removal is highly desirable. The vast majority of these tumors lend themselves to removal by electrosurgical methods, but the proper type of cutting current with the electric snare is necessary for their removal. Coagulation is sometimes an additional measure of value in the electric snare technique; it has been referred to as circumvallation, a procedure which produces a ring of coagulation in the mucosa around the snared off stump. This may destroy tumor cells already beyond the confines of the malignant base, and in any event, it interferes further with the circulation of the stump, assuring as much destruction as is possible without actual excision. The mucosa alone should be coagulated. Perforation is possible.

In some cases, the entire tumor may be destroyed by electrocoagulation and allowed to slough off—the so-called *démorsellement* of the French. This may be the method of choice in particular vascular tumors, in those with broad pedicles, or in unfavorable locations where operative interference is refused.

In large or multiple tumors above the peritoneal reflection, it may prove the safer and easier procedure to remove them by laporatomy with excision and resection, or extraperitonealization.

The selection of the most advantageous method may sometimes require experienced surgical judgment. It should also be noted that the technique of the electric snare is not so simple as described.

Polypoidosis, Multiple Polyposis. In these conditions, the entire colon is more or less involved, and electrocoagulation is only indicated and useful in the occasional case to destroy tumors in the area of the bowel where anastomosis is contemplated, usually after a graded colectomy.

Carcinoma. Electrocoagulation may be used as a justifiable palliative measure in inoperable rectal cancer, and undoubtedly in certain cases it has a systemic effect which is not yet completely understood. We have observed this many times and we

use coagulation in selected cases, combined with *x*-ray and radon implantation. Our material consists of cases of very advanced malignancy, in which our results have not been very encouraging.

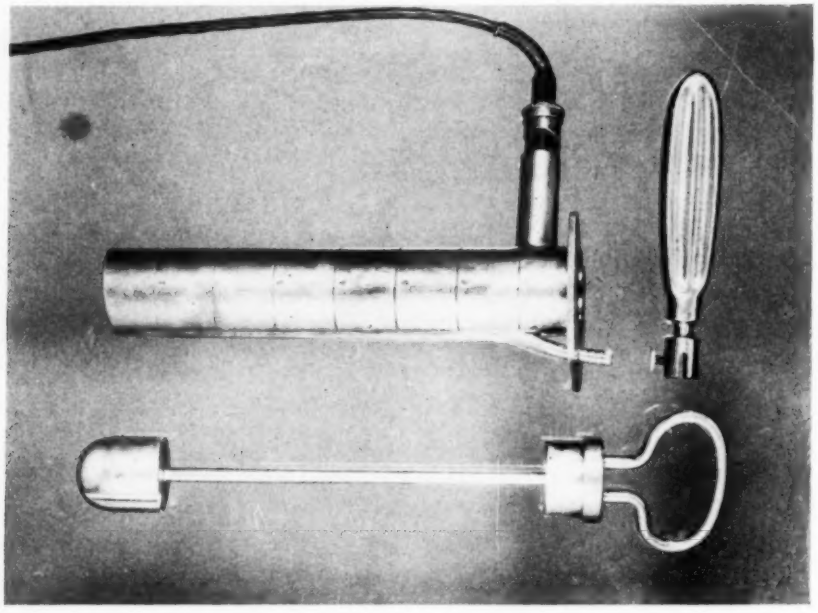

FIG. 1. Author's operating proctoscope with suction tube built in wall of tube and adjustable handle. Useful in the electrosurgical snare techniques.

One must not wax too enthusiastic about electrocoagulation cancer therapy. We have colostomized many advanced cancer patients who have improved very decidedly. They have lived in comparative comfort for two or three years, and in isolated cases, for five years, with no other treatment.

Binkley and others, emphasizing the value of deep *x*-ray therapy, have reported similar results.

Finally, a word of warning must be sounded lest many operable cases of rectosigmoidal cancer be sacrificed in the enthusiasm for coagulation. The cases of rectal cancer cured by coagulation are so rare that it certainly should never be offered to a patient with anything but the hope of palliation. It stands on the same questionable plane as *x*-ray and radium. Granted that these procedures have scarcely no mortality, surgery still offers the only hope of cure, and it unquestionably has cured the greatest number of patients over the greatest number of years.

The question of operability depends on too many factors to be discussed here, but it is sometimes a most difficult decision to make, and in questionable cases it should be left to experienced surgeons.

FULGURATION

Fulguration is a biterminal method frequently confounded with desiccation and coagulation. It refers to the use of long and hot sparks which are very caustic and produce rapid carbonization. There is no indication for its use in proctology.

ELECTROCUTTING

(Endothermy, Electrotomy, Radio-knife, Surgical Diathermy, Etc.)

This consists essentially in an electrical separation of tissue, the exact nature of which has not yet been entirely explained. The wounds produced by the electrosurgical knife differ from the ordinary incised wounds in that the desiccating effect of the electrically produced incisions varies not only in the different tissues of the same individual but also in different

individuals. The current may be of such intensity, or rapidity of frequency, as will produce an extremely rapid separation of tissue and so little desiccating effect that it will scarcely control bleeding from the finest capillaries. On the other hand, the current may produce a coagulating effect, leaving a charred surface of several millimeters or more in depth with considerable resultant sloughing (so-called coagulotomy).

Fig. 2. Large perineal granuloma before electrosurgical excision. Male, aged 32.

The accepted and proper niche for the cutting current in proctologic surgery has not yet been definitely established. It has been used more or less interchangeably with the time-honored scalpel, and while rejected in some quarters, it has been enthusiastically accepted in others. However, there are certain proctologic conditions and phases of surgical procedure in which the cutting current is of unquestioned advantage and these we desire to emphasize.

Adenoma "Polypi." The electric snare removal of accessible rectocolonic adenomata and other benign or premalignant tumors is a procedure worthy of greater consideration. Combined with electrocoagulation and the implantation of radon seeds, in selected cases it has proved to be a most gratifying and satisfactory method. It is real cancer prophylaxis.

Dudley Smith of California has devised and uses an electric cautery with suction for the removal of these tumors. In his hands, the method has apparently been quite satisfactory. However, in our experience, we have sometimes found it difficult in certain types of sessilated tumors to determine the exact plane of cautery cutting in relation to the surface of the mucosa. If the plane of cutting is not flush with the surrounding mucous membrane, additional cauterization becomes necessary and the exact depth of destruction is difficult to judge. The cautery, moreover, is not so readily used above the rectal valves and large mucosal folds behind which these tumors are sometimes found. These factors are largely overcome in the proper electric snare techniques.

The author's operating proctoscope with a suction tube built in the wall of the tube to clear the field of smoke (Fig. 3) and the high frequency snare (Fig. 4), are very useful for coagulation, cauterization or electric snare techniques in the rectum and sigmoid.

Malignancy, Granulomatous Lesions, Dermoids, Etc. The cutting current combined

with clamp coagulation or direct vessel coagulation has definitely widened the scope of cancer surgery in proctology,

FIG. 3. Same patient shown in Figure 2, after excision of granuloma by electrosurgery.

particularly in the debilitated and elderly patients in whom the diminished hemorrhage is of some importance. The coagulum on extensive wounds seems likewise to lessen the loss of fluids, the absorption of toxic wound products and to decrease post-operative pain. Figures 5 and 6 demonstrate the possibilities and result following the electrosurgical excision of an extensive perineal granuloma in a male, age 32, who was admitted to the New York Cancer Hospital as a hopeless inoperable case. This patient is today actively employed, happy and when reexamined by the author several weeks ago, presented no evidence of his original lesion. It is obvious that the possibilities of electrosurgery were not fully appreciated elsewhere.

We do not, however, consider that the electrosurgical technique has any such decided advantages in the usual combined perineoabdominal or the abdomino-perineal excision of the rectum or sigmoid; certainly not in the abdominal technique. In a simple amputation in debilitated patients, or in those who bleed readily, its hemostatic effect and the time saved in ligature tying and manipulation may be of some advantage; likewise in the excision of large dermoids, sacral teratomata, angiomata or other excessively vascular tumors.

Sacro-Coccygeal Sinuses and Cysts. If the cutting current is used for the excision of these sinuses, the resulting wound should not be sutured. Unless indicated, we likewise believe it unsurgical to coagulate the sacrococcygeal ligament or periosteum. The late sloughing materially delays healing, which is always protracted enough.

Fistulae. The cutting current would appear theoretically to offer very decided advantages in the excision or incision of fistulae. In simple straight tracks this is perhaps true, but in deep fistulae where fine dissection is demanded around the rectum or around the anal musculature, we have found the scalpel still the most sensitive and controllable weapon. One can appreciate cutting through diseased tissue with the scalpel, but with the cutting current such a distinction is not so readily made. The actual cautery likewise besmirches the field. It would seem that the advantages of the actual cautery or electrocoagulation could be secured after a careful scalpel dissection.

Hemorrhoids. We again mention, in passing, that we are decidedly opposed to the cutting current in any and all hemorrhoids.

Fissure. The skin incisions and dissections may be done with the cutting current in fissurectomy with drainage, but great care should be exercised in cutting through the anal musculature. The current separates muscle more readily than any other tissue.

Stricture. In selected cases of short tubular, or especially in the diaphragmatic type of stricture, internal proctotomy may offer some degree of palliation. This may be done with the cutting current, but only under direct vision. A single incision may be made through the entire length of the stricture posteriorly; additional lateral incisions are sometimes advisable. These incisions should not be carried through the anal musculature unless the latter is

involved. The cutting current has the advantage of causing less hemorrhage, which may be active in this location.

In external proctotomy, the incision must be carried and extended well posteriorly through the entire anal musculature for adequate drainage. In selected cases, the results are excellent, but the method is only justifiable in strictures of the anal canal proper. A combined internal and external proctotomy usually results in a paradoxical incontinence.

Biopsy. The cutting loop offers a very simple and effective technique in securing biopsy specimens from any part of the rectosigmoid accessible to the proctoscope.

Post-operative Gangrenous Ulceration. In the very exceptional case of post-operative gangrenous ulceration of the perirectal tissues, the cutting current with heavy coagulation in its wake (coagulotomy) offers decided advantages over the cold scalpel. The actual cautery may likewise be used with equal benefit in this condition.

APPARATUS

The market offers several excellent machines for the production of the various electrosurgical currents, usually combined with medical diathermia. For the proctologist the apparatus should offer the following features which we believe are essential to a complete proctologic armamentarium.

1. It should have an outlet for the Oudin current.

2. It should offer good diathermy current for medical diathermy.

3. Separate outlets for coagulation and cutting currents are an advantage, but not a necessity. Separate foot-switches for these currents may at first appear desirable, but the ease with which they can be inadvertently interchanged should be considered.

4. The tube machines producing oscillations of ultra-high frequencies theoretically produce cutting with less and a more even line of desiccation. In facial or other surgery this may be advantageous, but in rectal surgery the spark gap machine fulfils every requirement and is decidedly more rugged.

5. Special electrodes and snares are an essential part of the modern proctologic equipment.

For further detailed specifications on electrosurgical machines the reader is referred to the Council of Physical Therapy of the American Medical Association.

CONCLUSION

It may be emphasized that the modern practice of proctology demands a comprehensive knowledge of electrosurgical methods. These offer unquestionable advantages in selected cases and are distinctly contraindicated in others. Their indiscriminate use is to be condemned. They are not a substitute for sound surgical principles and training. A fundamental knowledge tempered with experience in the various phases of anorectal pathology is still a *sine qua non* to successful proctologic practice.

LOW BACK PAIN

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IN considering the subject of low back pain, the simulation of the symptoms arising from low vertebrocolumnar involvement, and those from abdominovisceral pathologies are readily confused. Pathology involving the prostate, perimetrium, uterus, etc., even remotely the kidney, might be associated with low back pain. A paranephritis, a rectocecal abscess from a chronically inflamed appendix, a duodenal ulcer—any of such visceral pathologies and others could be the hidden cause for spontaneous pain or other symptoms in the region of the lumbar spine, more especially in the upper segments. Visceral conditions offering such a symptom-complex will require the particular consideration for treatment centering upon the organ involved. One should be certain primarily to rule out the possible abdominovisceral involvements as causative factors for low back pain before making the decision that the entity is truly one for orthopedic concern.

That chronic low back pain, when it calls strictly for orthopedic attention, should be considered on the whole as most likely of the arthritides is wrong. Such pathologic systemic entities as osteitis deformans (Paget's disease), osteoarthritis fibrosa cystica (von Recklinghausen's disease), tuberculosis of the spine (Pott's disease), syphilitic arthropathies (tabes), etc., may be first identified by low back pain.

Nevertheless, when definite aids for diagnosis such as capsular thickening, marginal fringing, and fraying of the various skeletal articulations are present, they usually indicate that the pathologic entity of osteoarthritis actually exists per se. When these are found in the spine, the condition is more definitely designated as spondylitis deformans or spondylitis arthritica. However, it is surprising to realize how commonly arthritis occurs without articular involvement elsewhere in the skeleton. The condition, through its frequency in the lower back, is described as lumbosacral disease or lumbago.

No group of cases presenting low back pain offers a more pathetic picture than do parturient women. During pregnancy they may be given the best of care. The wearing of a support to relieve the load and stretch upon the abdominal and back musculature during the latter months of pregnancy has become almost routine. However, during delivery when there is such a terrific strain placed upon the structures of the lower back and pelvis, so much unusual stretching of the ligaments and muscles, possibly even tearing many of them, no particular after-care is undertaken. An essentially prolonged period of recumbency, beyond the usual ten to fourteen days, is rarely if ever considered. Subsequent proper support to the parts engaged during a difficult delivery are too often overlooked. In the normal delivery this may well be unnecessary, but normal deliveries, in which there has been no maternal slight, are less frequent than is believed.

The obstetrician contends with many abnormalities in the pelvic basin and lower back of the modern woman, many of which must create susceptibility to damage in these parts. When there has been injury or undue effort in delivery, more definite regard should be given to the great need for proper after-care. Rest and support to the severely strained and damaged ligamentous and muscular structures entering into the complicated physiologic process of confinement must be duly regarded. The sacro-iliac synchondroses and the amphiarthroses of the sacrum and lower lumbar vertebrae with their many ligamentous attachments must be allowed to involute.

Numerous joints—at least six—enter into the mechanism of delivery. Following

delivery, no period of time in recumbency shorter than four, or better still, six weeks should be allowed for any woman who has undergone a complicated labor through the normal route. Among women complaining of low back pain before the menopause a large proportion has a history of difficult pregnancies or labors.

Among men the complaint of minor injuries to the back during the active period of life is astounding. Many falls or wrenchings of the back in line of duty or sports have gone unattended and unrecorded. The complications or the manifestations of pathology in the back in these cases are never revealed until brought to light roentgenologically.

Frequently unrecognized causes for low back pain are the various congenital malformations existing in the lower portion of the spine, more especially from the fourth lumbar vertebra down to and including the sacrum. With such anomalies the deep-seated sacrum is common; the accompanying deep-seated fifth lumbar vertebra occasions increased lordosis and causes imbalances which result in muscle strain, spasticity and consequent low back pain. Spina bifida occulta, spondylolisthesis, incomplete sacralization of the transverse processes of the fifth lumbar vertebra, supernumerary and wedged or malformed lumbars and the associated factors, are the common origins of low back pain following strain or minor injury. These conditions, of course, remain unrecognized weaknesses or susceptible areas until strains and minor traumata bring them to the fore. Then they are definitely discovered only through roentgenologic findings. The frequency of anomalies, particularly in the lower spine, should justify our continual suspicion of their presence with the problems which they might develop until they are definitely excluded by the *x*-ray.

Spondylitis deformans or spondylitis arthritica is mostly confined to the lower back. In fact, it is my opinion that it is most common in this location, with the cervical type second in incidence but following quite a distance behind. The traumatic spine, particularly in the lower back, is invariably disregarded unless its manifestations are severe in character. The serious types of injury, with immediate and very early cord or nerve root involvement, do not and cannot go unrecognized, but European authorities (Mahler and Schmeiden) are of the opinion that where severe pathology has been ruled out, only 30 per cent of the spinal columnar injuries are seriously regarded and accorded early treatment. In other words, 70 per cent of the lesser back injuries go unattended unless grave complications develop.

The amount of damage which occurs because of neglect of low back injuries is astounding. Nerve root pressure on the lumbo sacral plexus following such damage is far reaching. It does not confine itself to the lower extremities and pelvic viscera, but, sympathetically, it may develop an upward course, frequently evidenced by involvement of the upper extremities, neck and head.

Liberally considered and for simplicity, lumbar spondylitis arthritica should be regarded as lumbago. This symptom-complex is a manifestation of vertebral arthritis of varying intensity in the lumbar articulations, presenting secondarily progressive evidences of inflammation to the nerves, muscles and other soft parts associated with the loins. In other words, if visceral pathology can be ruled out where there is low back pain, and the condition is to be regarded as of an orthopedic nature, the term lumbago will cover the subject generously, allowing for everything that is of direct pathologic significance in the lower back.

The commonest of all forms of low back pain is spondylitis deformans. This type of arthritis occurs in this location as spondylitis osteoarthritica, spondylitis ossificans ligamentosa, and spondylitis ossificans muscularis, separately or in combination. It develops most commonly among corpulent men and women with marked lordosis and rigidity of the erector spinae musculature. They complain of the greatest pain in the small of the back. They suffer from over-stretching of the muscular and

ligamentous structures in the iliolumbar and sacroiliac regions. They complain of a type of backache of long duration, extending progressively over a period of years. Among these cases, calcareous deposits frequently occur in and about the marginal bone, around the bodies and facets, extending in the surrounding vertebral muscles, ligaments and tendons. Inasmuch as these subjects are commonly past middle age, they rapidly approach the senescent type of osteoarthritis.

In all types of low back pain we should not fail to rely upon the help of the roentgenologist for identification of possible pathology in the lumbar, lumbosacral and sacroiliac regions. In many cases, an established painless scoliosis of the lumbar spine is discovered, which the patient strives unwittingly to correct. When there is direct and more or less continuous pain in the lumbar vertebrae, it arises, as a rule, where there has been long illness or suffering in the lower back or loin region. A circumscribed tenderness upon percussion over the lumbar spinous processes is a positive evidence for backache, involving the articulations. Chronic backache precipitating an acute lumbago should present positive roentgenologic findings, such as changed vertebral configurations, dissolution or narrowing of the intervertebral discs, fractures (as impaction of the body or separation of a transverse or spinous process), fissurings, exostoses, bridgings (as in Bechterew's disease), osteoporosis, or other bony abnormalities which bespeak systemic disease (metastasis, osteomalacia, tuberculosis, syphilis, etc.).

Severe pain upon pressure over the spinous processes in the lumbar region and described as ascending toward the head, with no limitation of movement, even with positive roentgenologic findings, should be considered as of neuropathic origin.

In lumbago, the pain in the lower back is usually sudden in onset and of great severity during movements, but there is no pain over the spinous processes. Where there is weakness of the extremities, impairment of the bladder and rectal functions, as well as reflex changes and accompanying backache, there is damage which involves the cord or nerve roots, and we must consider tabes or cord pressure. Pain in such involvement occurs spontaneously and is not evidenced upon movements of the trunk such as turning in bed. Furthermore, the pain is not limited only to the back, but radiates away from the lesion site.

Chronic spondylitis of the lower vertebrae is confirmed through sharp pain evidenced in this region during maneuvers of sudden loin or waist twisting. A jolt to the shoulders also occasions similar pain. This is accounted for through the presence of muscular rigidity in the painfully affected portion of the vertebral column where there is present an established point of greatest tenderness. It is quite different in the case with fracture of a lumbar vertebra. In such an injury a thoroughly fixed lower back region exists, making it impossible to bend or twist the trunk. All torsal movements are performed with an unchanging stiff back, the motion coming from the hips.

Before closing, a word must be said regarding low back pain due to improper posture of the feet and legs. Pronation symptoms, acute problems arising from varying types of foot trouble, occasioning variation in carriage, etc., will often give rise to this distant disturbance. Although of great disabling significance, it is easily corrected with proper footwear. The correction with proper shoes is surprisingly rapid and complete.

CONCLUSION

Orthopedically low back pain is common. Yet it is ordinarily disregarded as a serious entity in spite of very definite pathology in the lumbar and lumbosacral spine, the related soft structures, or both. When considered as lumbago it merits the specific treatment which the clinical and roentgenologic diagnoses establish. And treatment, it is well to know, offers for the most part satisfactory end results. Chronicity is far advanced in most cases when they are finally seen by the orthopedist, but the arrest of the progressive factors, although slow, is definitely established.

FRACTURES OF THE HIP JOINT*†

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FRACTURE of the neck of the femur, especially of the so-called intracapsular type, is one of the most distressing results of an injury. Occurring mostly in elderly people, often with associated disease of the cardiovascular system, it often results in complications of a serious nature, particularly if the patient is long bedridden. Non-operative methods of treatment have been many and varied, and since the introduction of the classical method of Gordon Buck, some form of extension by adhesive plaster, pulleys and weights has been the method of choice. The Thomas splint, Jones abduction splint, the Hodgen splint and more recently the so-called Russell method have been used extensively. Various special appliances and splints have been developed but are not in general use. In 1904, Whitman advocated the use of abduction with fixation in a plaster spica, and this is now a standard method of treatment. Any complete discussion of the value of these methods is not possible nor concerned with the object of this paper.

The operative treatment of the recent intracapsular fracture has been discussed by surgeons for a number of years. Gwilym G. Davis was among the first to do a nailing operation; later Albee suggested a peg of bone cut from the tibia, Davison a segment of the fibula. Revival of interest in this method of treatment took place when Smith-Petersen published his paper in 1931, advocating the use of the flanged nail which bears his name. Modifications of this nail have been offered and Johannson and others have advocated an extra articular method by which the nail is guided over a wire under *x*-ray control with the fluoroscope. At a recent meeting of the American College of Surgeons in Philadelphia, Smith-Petersen stated that he had changed his technique and is now using the extra articular method with the use of the Kirschner wire as a guide.

In the first operation, Smith-Petersen made use of an anterior incision for the exposure of the hip joint (for further details one is referred to his article) and of a flanged nail, which brought about absolute fixation of the fragments in all directions, and displaced the minimum amount of bone. Because of its flanges, the nail is gripped by the cortex of the bone, so that there can be no rotation on account of its shape, and the surface area is much greater than that of the ordinary nail. Friction is proportionately increased on account of the minimum displacement of bone and there is less pressure necrosis surrounding it: consequently the fixation is sustained and complete, not temporary and partial.

The postoperative care is the application of plaster spica, which is split, and application of 5 pounds traction. The cast is bivalved after three weeks, and the patient is gotten out of bed, with cast. This is carried out for a period of four to six weeks, and then the patient should have some support in the form of a plaster spica or leather spica for three to six months depending upon the *x*-ray studies. The nail is removed at any time after six months if firm union is present. In the twenty-four cases reported, non-union occurred in four, and these were attempted at ten, fifteen, nineteen months, and two and one-half years, respectively.

E. Denegres Martin, in 1933, advised the use of carpenter screws and Hodgen's splint, with six weeks in bed, and has obtained splendid results.

* From the Service of Dr. George P. Muller, Misericordia Hospital.

† Read before the Philadelphia Academy of Surgery, January 4, 1937.

A. T. Moore, in 1934, has obtained good results by the use of three drill pointed stainless steel pins which are inserted at varying angles, with their points converging to form an equilateral triangular base, and the protruding ends of the drills must be left so that subsequent removal is easy. The position of reduction and of the pins is checked by roentgenogram or the fluoroscope. When the pins are in perfect position, six drill holes are made through the neck and up into the head of the femur. If the patient's general condition permits, he is out of bed the next day. No plaster or other retentive apparatus is necessary. When union is found solid, the pins can be removed at the office under local anesthesia.

John Hoets, in 1935, advised the use of the Smith-Petersen nail and made the following postoperative changes: no apparatus is applied other than a pillow under the knee for comfort, and the patient is permitted to sit up in bed in several days.

The reason for Smith-Petersen nail success is that it prevents rotatory as well as angulatory movements of the fragments and allows immobilization to be continued for six to twelve months without hardship to the patient. In Jones' experience he has noted that one should operate early; operation is not advisable after the first six or eight weeks in high fractures where there is a probability that the blood supply of the head is impaired. He also advises a new exposure of the hip joint, as in one case of the Smith-Petersen type he had a case of flap necrosis. He also uses a guide for the nail, and advises discontinuance of the use of the spatula, for he feels that it causes osteoarthritis of the joint. He states that blind and uncontrolled impaction of the nail is valueless, destroying the cancellous bone, shortening the femoral neck, and may increase the tendency to arthritis by bruising the articular surface. Postoperatively, he does not use plaster spica or other external fixation, and knee movement starts the day after operation. A bedroom slipper with a six-inch piece of wood nailed on the heel and projecting outwards, is used to prevent external rotation. Weight bearing is started in from four to six weeks depending on the site of fracture. The high type of fracture weight bearing is not started for three months. He has found firm union in four to six months.

F. D. Dickson, in a review of his cases, reaches the following conclusions:

1. Whitman abduction method with modification is the method of choice.

2. In the obese type of patient one should use the Smith-Petersen nail provided there are no contraindications to surgery, as in these cases plaster spica gives poor results.

3. If anteroposterior and lateral Roentgen ray studies indicate unsatisfactory reduction, a Smith-Petersen nail is indicated.

4. If, after three months of conservative treatment, there is a poor result, then Smith-Petersen operation is indicated with a small bone graft taken from the trochanter and placed along the neck of the femur and into the head of the bone, or an Albee bone graft may be performed.

Gaenslen, in his Sir Robert Jones Lecture, stated that the impacted fracture holds the key to solution of the most important problems involved, such as complete apposition and immobilization of fragments, absence of serious damage to vessels, absence of interposed capsule, and resumption of early motion relative in frequency of aseptic necrosis. Therefore, he advises absolute reduction and also spike fixation if necessary to obtain bony union. Aseptic necrosis of the head is the big factor, and is due to lack of circulation in the head fragment; in impacted fracture the circulation is less damaged and fixation is sufficient to allow uninterrupted progress in repair. In fractures that are not impacted, there occurs muscular contraction, even though a double spica is applied, which may very well result in a slight shearing motion of the fracture surfaces one on the other. If internal fixation is used, muscular contraction can result only in intermittent pressure in the direction of

longitudinal axis of the neck, thus not obtaining the shearing factor and therefore

capsular fractures treated for the past ten years, prior to September 1935, and found

TABLE I

Type of Apparatus	Age and Sex	Number of Hospital Days	Amount of Shortening	Union	End Result
1. Whitman cast	Female 80	150 days	1½ inch	No	Died at home one month later. Was always bed-ridden.
2. Whitman cast	Female 70	81 days	None	Yes	Walked 5 months after accident.
3. Bucks extension	Female 64	79 days	1 inch	?	Walks with assistance of cane Refused to be re-rayed.
4. Russell extension	Female 63	45 days	None	Yes	Sent home, there re-fractured it.
5. Russell extension	Female 75	45 days	None	Yes	Walked in seven months.
6. Whitman cast	Male 75	57 days	¾ inch	Yes	Walked in five months
7. Russell and cast	Female 78	191 days	1½ inch	None	Bed-ridden
8. Whitman cast	Female 88	2 days	None	None	Died two months after accident, bed-ridden
9. Whitman cast	Female 76	15 days	None	?	Patient mentally incompetent and therefore kept in bed. Never re-rayed.
10. Russell extension	Female 77	156 days	1½ inch	Fibrous	Walks with crutches.
11. Russell extension	Male 60	59 days	½ inch	Yes	Walks without crutches in nine months.
12. Russell extension and Whitman cast for 6 months; then Smith-Peterson operation.	Male 37	9 months	1 inch	No	Uses crutches.
13. Russell extension for 9 weeks; then Smith-Peterson nail.	Female 70	12½ weeks	1½ inch	Yes	Uses crutches.
14. Russell extension for 3 weeks; then Smith-Peterson operation.	Male 66	72 days	None	Yes	Walked without support in 6 months.
15. Russell extension—10 days; Smith-Peterson operation.	Female 58	41 days	None	Yes	Walked without support in 3 months.
16. Russell extension—12 days; then Smith-Peterson operation.	Female 61	42 days	None	Yes	Walked without support in 5 months.
17. Russell extension. Refused operation. . .	Male 73	90 days	1 inch	None	Bed-ridden—Convalescent home.
18. Russell extension—9 days; Smith-Peterson operation.	Female 65	45 days	None	Yes	Walked without support in three months.
19. Russell extension—7 days; Smith-Peterson operation.	Female 63	40 days	None	Yes	Walks without crutches in three months.
20. Russell extension—9 days; Smith-Peterson operation.	Male 55	42 days	None	Yes	Walked without cane in 3 months.
21. Russell extension—21 days; Smith-Peterson operation.	Female 64	58 days	None	Yes	Died; x-ray revealed callus in forty days.

stimulating bone formation. Early activity is thus a factor promoting union.

After reviewing the literature, our service decided to review the cases of intra-

eleven in number. They were treated with Bucks extension, Whitman cast, Russell apparatus or a combination of these, with but fair results.

SUMMARY AND CONCLUSIONS

Our technique was as follows: Immediately upon admission, Russell extension was applied, and cardiac, renal and blood studies made. We tried to operate within the first two weeks (contrary to our early practice). After operation the patient was again placed in Russell extension (this was done in all cases except the first, in which cast was applied as suggested by Smith-Petersen). The patient was kept in bed for three weeks, extension removed, and baking and massage started. Two or three days after the removal of extension, the patient was out of bed and was taught to use crutches. One and one-half months later, he was told to use a cane. Before the cane was discarded, the *x*-ray film had to show solid union. All patients walked without any support in from three to seven months, except two who are still using crutches.

Although a short series of cases is reported, one cannot but be impressed by the splendid results obtained by nailing and following the Smith-Petersen technique. If this technique is to be followed, the nail should be inserted within the first two weeks, provided the patient's general condition permits.

The open type of operation is advocated because one sees the fracture site, reduction is accomplished, and *x*-ray guidance is not required. A closed type of reduction, unless combined with proper *x*-ray guidance and equipment, should not be attempted.

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FEMORAL HERNIORRHAPHY*

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DURING the past sixty years there have been over one hundred different surgical procedures devised for the cure of femoral hernia and new operations are constantly appearing in the surgical literature. The City of London Truss Society 1921–1927 reported 27 per cent failures from the various types of herniorrhaphy. The Americans reported from 8 to 30 per cent failures and the German and French writers showed from 8 to 36 per cent recurrences.

Types of Procedures. It is impossible to go into details concerning the different operations for femoral hernia. There are the low type operations, or those which are performed below the inguinal (Poupart's) ligament, and the high type, or those above the inguinal ligament. Most of the procedures use some form of closure of the femoral ring. Certain of the operations distort the femoral ring. I have heard A. J. Ochsner say in his clinic: "When the circular femoral ring is closed with plain catgut, the percentage of recurrences is small. When the orifice is sutured with chromic catgut the percentage of recurrences is greater. When silk is used, the recurrences are still more numerous. When the femoral ring is distorted by an attempt at closure with silver wire, most of the operations fail."

The author of a recent book on surgery states that the most important thing in the cure of a femoral hernia is the use of a strong suture material. I feel that instead of assuring better results, this method offers a greater percentage of failures. The use of the high operations is more and more advised. It is my opinion that these procedures are more complicated than a simple low operation and not so applicable in the largest percentage of cases.

Saccular Theory of Russell. R. Hamilton Russell of Melbourne, Australia has shown that the femoral sac is an abnormal constituent of the lower limb due to a developmental defect. The femoral sac is present at birth, or grows downward with the leg after birth, and follows the course of the upper branches of the femoral artery as a result of an abnormal attachment of the peritoneum to the sheath of the femoral artery.

Practical Application. Clinical evidence and "living pathology" point to the correctness of the saccular theory. This being true, the treatment of femoral hernia would be different than if it were based upon the theory that the peritoneum is pushed through the femoral ring as the result of intra-abdominal pressure in adult life. In 1879, Socin suggested the simple removal of the sac as a radical cure of femoral hernia.

Later Ochsner said that it was not possible to keep any circular orifice in the body open if it were denuded of its natural mucous or serous lining. If the mucous membrane were removed from the mouth or from the anus, the openings could not be kept from closing. Ochsner pointed out the fact that the normal femoral ring is anatomically a circular opening and when associated with a femoral hernia it has a serous lining. He began operating for femoral hernia in 1892 by removing the hernial sac and suturing the skin. He told me that he had never seen a recurrence following a femoral herniorrhaphy when the above method was used, but he had always a certain percentage of recurrences

* Read before the meeting of the North Central Illinois Medical Association at Streator, Illinois, December 2, 1936.

following inguinal herniorrhaphy regardless of the method employed. I have never seen a failure with this operation during the time I was on the surgical services of Ochsner and Nelson M. Percy, at the Augustana Hospital in Chicago. I have used the procedure advocated by Ochsner continuously since I was his assistant eighteen years ago and have not seen a recurrence in my own experience. Dr. Percy recently told me that when he began his internship in 1899 at the Augustana Hospital, Dr. Ochsner had been using the method for a number of years. Dr. Percy further said that he had never seen a single recurrence since that time in his own personal experience, which has been a most remarkable one.

In a memoir of Ochsner, Dr. William J. Mayo states: "He was the first to point out that in cases of femoral hernia, if the sac was thoroughly freed, ligated, and dropped back, sutures were unnecessary, because the circular opening would heal to the center if it was not disturbed."

Adaptability of the Method. The simple procedure of removal of the sac followed by closure of the skin should be used in those patients who present a femoral ring which has not been distorted. It is not applicable to those who possess a congenitally defective femoral ring or in those who have a ring that has been torn due to traumatism or disfigured from some infection. It cannot be used in an operation where there is a large femoral defect, or for those patients suffering with strangulated femoral hernia.

Operative Procedure. The method I have used is as follows: An incision is made over the femoral sac. The sac is dissected free, opened, then explored. The contents are returned to the abdomen. Any adherent piece of omentum is ligated and excised. The sac is carefully examined again to see that it is not adherent to any part of the femoral ring. If further dissection is necessary special care is observed not to injure the femoral ring. The sac is transfixed high up with plain catgut so that it retracts into the abdominal cavity when it is excised. In cutting off the sac, sufficient peritoneum is left beyond the ligature to prevent it from slipping. Any fat in the ring is removed with a piece of gauze. The skin is closed and a dry sterile dressing applied.

R. Russell has advocated twisting the sac and crushing it high up before applying a ligature. When the peritoneum retracts, it forms a sort of tent inside the femoral ring. I have not used this procedure, but it is a very logical one. I have never applied a pad over the ring when the dressing is put on, as suggested by Russell.

Surgical Treatment in Strangulated Femoral Hernia. When a strangulated femoral hernia is present, it is frequently necessary to cut the femoral ring medially. In this incision of the femoral ring, care is taken to avoid an abnormal obturator artery which may pass downward along the medial edge of the femoral ring if the artery arises from the inferior epigastric or the external iliac artery. If the removal of the constriction only is necessary, the sac is excised in the usual manner and the femoral ring is restored to a circular opening by means of a few interrupted chromic sutures. When intestinal resection is indicated laparotomy is necessary.

Surgical Treatment of a Large Femoral Defect. When a large femoral defect is present, the method of Edmund Andrews is advocated. If the conjoined tendon is developed, it is sutured to the pubes. In the absence of the conjoined tendon the defect is repaired by sewing a turned-in flap from the external oblique aponeurosis.

Results of Femoral Herniorrhaphy. Recurrences will not occur following femoral herniorrhaphy when the circular femoral ring is maintained.

When it is necessary to incise the femoral ring a simple closure of the defect without an attempt to obliterate the ring will offer the best results. A certain percentage of recurrences will follow this type of operation.

If there is a large femoral defect, the operation suggested by Edmund Andrews is the most satisfactory.

SUMMARY

The percentage of recurrences following femoral herniorrhaphy is too high.

My experience has borne out the conclusion of my former chief, A. J. Ochsner that the percentage of recurrences following femoral herniorrhaphy is in direct proportion to the thoroughness of the operation.

In any operation for inguinal hernia there will be a certain percentage of recurrences regardless of the type of operation.

A patient anticipating a femoral herniorrhaphy may be assured that he will not have a postoperative recurrence.

CONCLUSIONS

1. In the surgical treatment of a simple femoral hernia all that is necessary is the complete removal of the sac and the closure of the skin.

2. This type of herniorrhaphy is only adaptable when the circular femoral ring is not distorted and does not apply when there is a large femoral defect, nor is it applicable for the relief of a strangulated femoral hernia.

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CASE REPORTS

ULCERATING CARCINOID TUMOR OF MECKEL'S DIVERTICULUM

CASE REPORT*

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TUMORS of Meckel's diverticulum are still of sufficient rarity to warrant the addition of single new case reports to the medical literature.

Ewing[10] stated that the incidence of Meckel's diverticulum was 2.7 per cent of the population. Balfour[1] reported the occurrence of fifteen examples in 10,600 autopsies (0.14 per cent). Telling[40] reported finding thirty-nine cases in 13,068 consecutive necropsies (2.99 per cent). Nygaard and Walters[26] placed the incidence of Meckel's diverticulum at between 1 and 2 per cent. They added that this anomaly occurred three times more frequently in the male sex.

Tumors of Meckel's diverticulum are very rare. Nygaard and Walters[26] stated that they had found only seventeen cases of malignant tumors of this diverticulum previously reported in the available literature, and added an additional operative case of their own. This was a leiomyosarcoma of a low grade of malignancy. They also mentioned two additional instances: that of Gray and Kernohan[12] which was a true adenocarcinoma, and a case found by Kernohan[18] in which the tumor, diagnosed as a leiomyosarcoma, had been removed by Dr. E. Starr Judd in 1926. Liccione,[20] following his review of the literature, listed six sarcomas, four carcinomas, two medullary carcinomas, three myxomas of indefinite origin, and three tumors of very dubious nature. He added a new operative case of a spindle cell sarcoma. Copeland[6] found one tumor of a Meckel's diverticulum in 50,000 pathologic specimens at the Johns Hopkins Hospital (0.002 per cent). Of the thirty benign and malignant tumors previously described in the literature, only four (13.33 per cent) were undoubted instances of carcinoid tumors. The case mentioned by Hicks and Kadinsky[16] was said by Stewart and Taylor,[39] who examined some of the original tumor tissue microscopically, to represent only an example of heterotopia of the gastric mucosa. Cooke's[5] reference to an additional case of a carcinoid tumor of Meckel's diverticulum, besides the true instance reported by Stewart and Taylor,[39] has been unverified. The four previously reported carcinoid tumors occurring in Meckel's diverticulum include those described by Stewart and Taylor,[39] one case; Price,[30] one case; and Hertzog and Carlson,[15] two cases. The latter authors found their two instances among 6,138 necropsies (0.03 per cent) conducted at the Mayo Clinic. Chart 1 tabulates the data on these previously described four examples and that of the new case we wish to add.

Lubarsch,[22] in 1888, was the first investigator to differentiate carcinoid tumors from carcinomas of the gastrointestinal tract. Ransom,[31] two years later, substantiated Lubarsch's[22] findings and proposed the use of the differentiative term "carcinomata" to distinguish these atypical tumors from

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CHART I

SUMMARY OF DATA OF FIVE CARCINOID TUMORS OCCURRING IN MECKEL'S DIVERTICULA

Author	Year Reported	Patient		Source of Specimen	Silver Reaction	Size of Tumor	Locality Reported from
		Age	Sex				
Stewart and Taylor	1926	54	M.	Post-mortem	Yes	"Pea-sized"	Leeds
Price	1935	54	F.	Surgical. Died on second postoperative day of paralytic ileus	No	1.5 cm. in diameter	London
Hertzog and Carlson	1935	54	M.	Post-mortem	Yes	4 mm. in diameter	Mayo Clinic
Hertzog and Carlson	1935	58	M.	Post-mortem	Yes	3 mm. in diameter	Mayo Clinic
Collins, Collins, and Andrews	1937	56	M.	Surgical. Living and well	Not done	6 mm. in diameter	Hollywood, California

CHART II

THEORIES AS TO THE ORIGIN OF CARCINOID TUMORS OF THE GASTROINTESTINAL TRACT

Author	Year	Theory as to Origin
1. Lubarsch	1888	Derived from non-designated cells of crypts of Lieberkühn
2. Marchand	1907	Derived from embryonic remnants of ductus omphalomes-entericus
3. Trappe	1907	Derived from pancreatic tissue displaced during fetal life
4. Toenniessen	1909	Derived from embryonic epithelial rests
5. Huebschmann	1910	Derived from Schwalbe's or Paneth's granular cells in crypts of Lieberkühn
6. Saltykow	1912	Derived from islands of Langerhans in the pancreas
7. Burckhardt	1912	Derived from cells similar to basal cells of epidermis
8. Hageman	1919	Derived from embryonic heterotopic tissue
9. Danisch	1923	Derived from cells of celiac ganglia (sympathetic nervous system)
10. Wolfer	1926	Derived usually from Schmidt's cells of crypts of Lieberkühn, but may originate from misplaced groups of Langerhans island cells, or from other chromaffin cells
11. Ehrlich	1926	Derived from cells of Auerbach's plexus (sympathetic nervous system)
12. McGlannon and McCleary	1927	Derived from chromaffin granular cells in the crypts of Lieberkühn
13. Masson	1928	Derived from certain cells at the bases of the crypts of Lieberkühn which wander into periglandular plexi, become filled with argentaffine granules. One solid cell type originates from the Remak cells and another rosette type is derived from the Kulchitsky cells
14. Semroth	1928	Derived from faulty differentiation of the entoderm
15. Price	1935	Undecided as to whether these are: (1) true carcinomas; (2) basalomas analogous to Krompecher's basal cell tumors of the skin; (3) pancreatic rests; (4) chromaffinomas derived from Kulchitsky cells of the crypts of Lieberkühn and are therefore tumors of the paraganglia
16. Hertzog and Carlson	1935	Undecided as to whether these are: (1) entodermal cells arising from intestinal epithelium; (2) ectodermal cells which have migrated to the intestinal epithelium from the chromaffin tissues of the body.

true carcinomas. In 1907, Oberndorfer[27,28] was the first to use the descriptive term "carcinoids." Five years later, Batzdorf[2] and 325 examples of appendiceal carcinoid tumors. Sixty-five per cent of these tumors occurred in females. The finest recent

FIG. 1. Gross appearance of the Meckel's diverticulum showing three of the four smaller diverticula situated at the tip. A puckered scarred area can be seen at the base of the middle secondary diverticulum. The photomicrographs of the tumor were taken through this scarred area.

was able to collect from the medical literature of his day, 114 instances of appendiceal carcinoid tumors and an additional 243 examples from the rest of the gastrointestinal tract. In the latter group of 243 cases, only forty-seven individuals were less than 30 years of age, while the average age was found to be in the early fifties. This finding was in accord with these five cases, comprising the known carcinoid tumors of Meckel's diverticulum.

Simon,[38] in 1916, presented his classical description of carcinoid tumors occurring in the appendix, to which little has been added by subsequent observers. He listed 447 references to the literature of his time

description of carcinoid tumors of the small intestine was presented by Cooke[5] in 1931. He collected 104 cases, twenty-one of which were malignant. Of the malignant tumors, metastases occurred to the regional lymph nodes in eleven instances and in eight additional cases, distant metastases were discovered in the liver. Of the eighty-three benign instances, only six were removed surgically. The sex distribution was nearly equal in seventy-nine patients. The average age in sixty-eight benign tumors was 54.3 years. Greenblatt, Pund, and Chaney[13] found eighteen Meckel's diverticula in 9,000 laporatomies (0.2 per cent). One of these diverticula had a tumor composed of

a benign heterotopia of bile ducts, pancreatic tissue, and duodenal mucosa. Schaetz[34] found that about 45 per cent of the tissue of

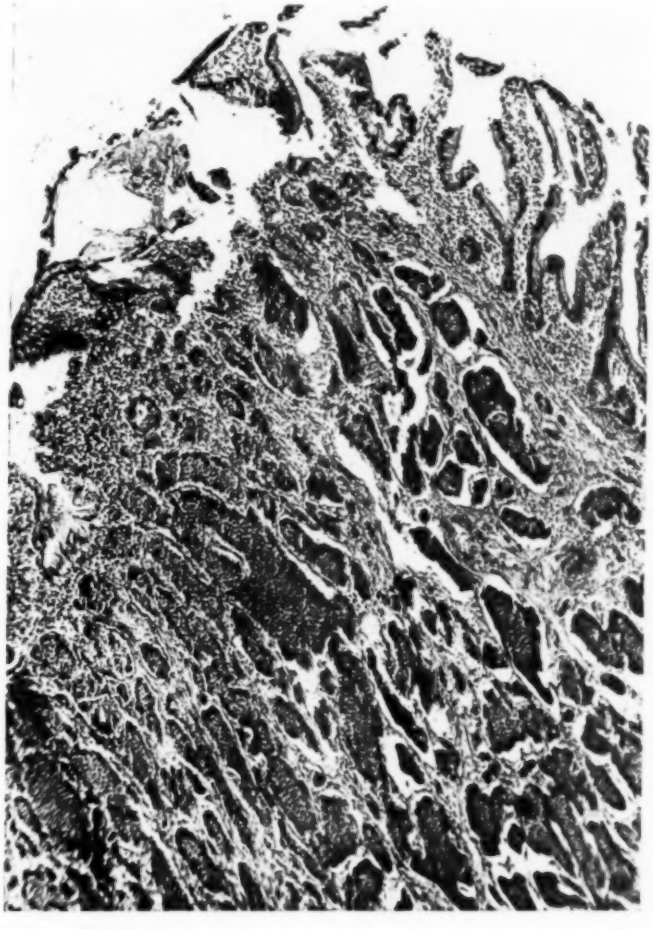

Fig. 2. Photomicrograph of the tumor, showing mucosa of the ileum and the typical carcinoid tumor morphology. (× 26.)

diverticula was heterotopic and that 38.5 per cent of these heterotopias were composed of gastric mucosa.

There are numerous theories as to the origin of carcinoid tumors in the gastrointestinal tract. Chart II summarizes the data in this respect. Ewing[10] concluded in regard to these tumors: "Multiple benign embryonal carcinoid tumors of the intestine constitute a peculiar group of tumors of the small intestine first described by Lubarsch. In structure they form three groups, resembling: (a) pancreatic island tissue; (b) heterotopic intestinal mucosa; or (c) Brunner's glands."

Cooke,[5] summarizing the evidence presented up to 1931, concluded that there are a number of unproved theories in regard to the histogenesis of carcinoid tumors and that as yet a final opinion has not been reached.

CASE REPORT

A white male, aged 56 years, presented himself for examination at the Hollywood Hospital, having been referred by Dr. Walter C. Alvarez of the Mayo Clinic. His chief complaints were generalized abdominal pain and distention several hours after eating, relieved by belching or by the ingestion of additional food. This complaint had been present for the past fifteen years. During this same period of time, there had been a progressive weight loss of 78 pounds. The patient was a real estate broker by occupation.

His health had been excellent until 1912, when intermittent crampy right lower quadrant abdominal pain made its appearance two hours after meals. There was also pain at night. The ingestion of food or soda gave very prompt relief. At no time was jaundice, vomiting, nor tarry stools noted. An appendectomy was performed elsewhere for "chronic appendicitis," but this operation gave the patient no relief from his chief complaints. After he had suffered for an additional seven years, another surgeon made a diagnosis of a chronic gastric ulcer and performed a local excision of the ulcer in combination with a posterior gastroenterostomy. The patient then enjoyed fair health for about two years. However, during the past fifteen years, his original complaints had returned with such a progressive severity that he had been unable to work for several years. In addition to his chief complaints, he had recently developed rather constant marked abdominal distention together with an inability to pass much flatus.

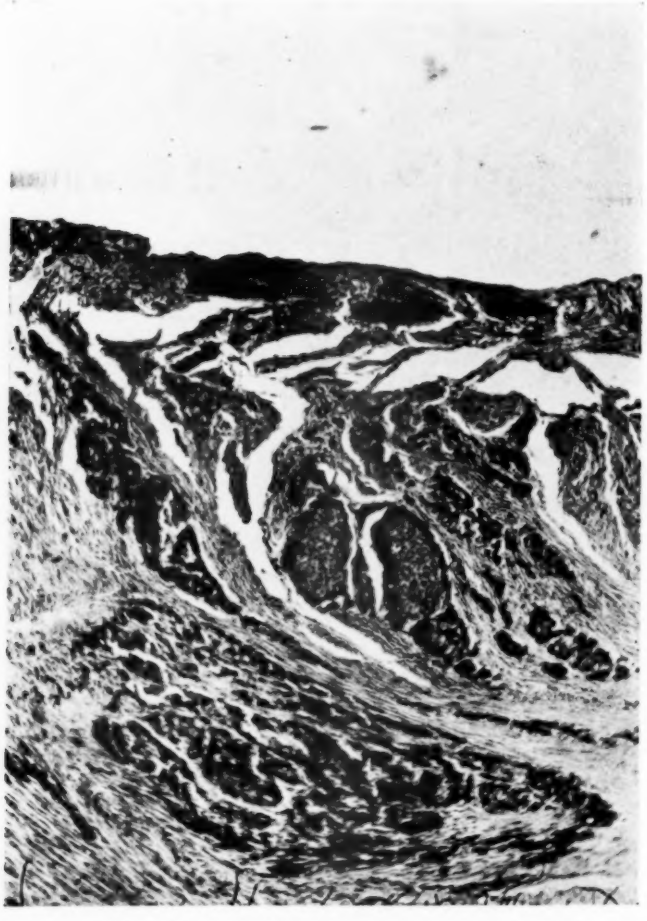

FIG. 3. Photomicrograph of another section of the tumor showing invasion of the muscularis of the Meckel's diverticulum. (× 14.)

The important positive findings in the physical examination were as follows: The patient was an emaciated white male, 5 feet 10 inches in height, whose body weight was 101 pounds. He was edentulous. The tonsils revealed chronic hypertrophic tonsillitis. The thorax was of the emphysematous type. Numerous asthmatic râles were heard throughout both lungs. The abdomen was thin walled and moderately distended. Well healed McBurney and upper midline incisions were present. The liver edge and spleen were not palpable. No masses were felt. Moderate diffuse tenderness was elicited about the umbilicus. There was slight muscle guarding in this area. There was no rebound tenderness nor generalized muscle rigidity found. The abdomen was tympannitic through-

out. Auscultation revealed the presence of noisy and tinkling peristalsis, suggestive of an incomplete low grade, lower ileum, bowel bronchial markings. Roentgenologic examination of the gastrointestinal tract depicted a slowly emptying posterior gastroenterostomy,

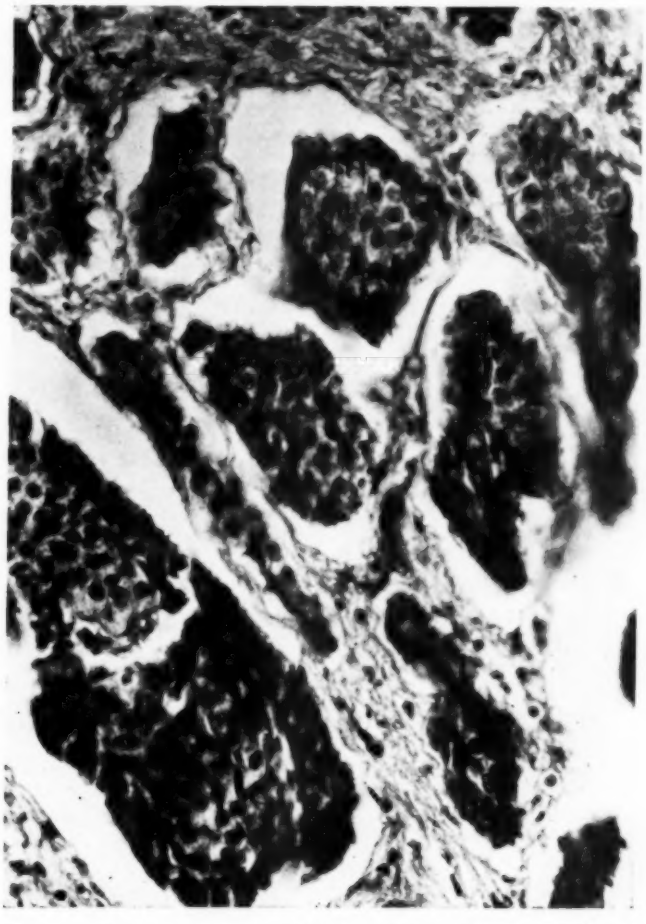

Fig. 4. Photomicrograph showing the cytologic details of the tumor, clearly demonstrating the characteristic appearance of a carcinoid tumor. (× 120.)

obstruction. Rectal examination was negative, as was the rest of the physical examination.

The laboratory studies were briefly as follows: The hemoglobin determination by the Sahli method was recorded as 85 per cent. The erythrocytes numbered 4,410,000 per cubic millimeter of blood. The leucocytes were 10,850 per cubic millimeter of blood, while the differential count showed 70 per cent polymorphonuclear neutrophiles. The coagulation time was three and one-quarter minutes. The urine examination was negative. Gastric analysis revealed a total acidity of 20 degrees, or 0.730 per cent, and free hydrochloric acid of 8 degrees, or 0.292 per cent. The blood Wassermann and Kahn tests were negative for lues. The lung roentgenogram only revealed increased peribelieved to be caused by mechanical factors. No other abnormalities were noted.

Our preoperative diagnosis was a malfunctioning posterior gastroenterostomy; possible gastrojejunal ulcer; low grade incomplete lower ileum bowel obstruction caused by postoperative adhesions; old chronic bronchial asthma; marked emaciation.

An exploratory laporatomy was done on September 30, 1936. The former upper abdominal scar was excised. Numerous firm fibrous adhesions were divided around the site of the posterior gastroenterostomy, and also between the anterior abdominal wall and several loops of the terminal ileum which had sharply kinked the latter in several locations. Examination of the posterior gastroenterostomy

stoma under direct vision failed to reveal the presence of either inflammation or a gastrojejunal ulcer. Not being satisfied with these findings, a thorough abdominal exploration was done. This disclosed the presence of a Meckel's diverticulum situated about 80 cm. above the ileocecal valve, and measuring approximately $6 \times 2 \times 2$ cm. One area at the tip of this diverticulum was scarred and puckered, resembling an old peptic ulcer scar, and there was considerable inflammation present in the adjacent portions of the ileum. The Meckel's diverticulum was removed and the defect in the ileum sutured transversely to the longitudinal axis of the ileum, so as to obviate a subsequent lumen stenosis. The operation was concluded without further incident.

Dr. V. L. Andrews, pathologist of the Hollywood Hospital, described the specimen as follows: "Specimen is a diverticulum: it measures in length 3 cm., and 1.75 cm. in thickness. From this larger diverticulum, there extend four smaller diverticula or pockets. One of these measures 7 mm. in length by 6 mm. in thickness. From one side of this diverticulum there is a definite scarring or puckering as though there might be an ulceration on the side; this measures 6 mm. in diameter and on palpation, before opening, a distinct hardness and thickness may be felt. On opening, the little pockets extending into the smaller diverticula are easily noted. Mucous membrane is present over all, and the hardened firm area lying over the scar noted on the outside is slightly elevated and ulcerated on its inner surface. Microscopic examination of a section through the nodule noted in the wall of the diverticulum shows this to be a tumor growth of small oval cells in which the nucleus makes up the larger part of the cell. The chromatin of the nucleus is broken up and very little cytoplasm is present. These cells occur in large and small groups and infiltrate into the muscularis of the diverticulum. There is no attempt at gland formation and the cells have penetrated to the serosa. This undoubtedly accounts for the scarring of the serous surface. There is no intercellular substance, but between the groups of cells there are small fibrous strands. The picture is quite typically that of a carcinoid or an argentaffine tumor." (Figs. 1–4.)

Aside from a superficial skin separation of a portion of the incision, due to the patient's poor emaciated condition, which required a secondary closure, the patient made a slow but satisfactory convalescence. His bronchial asthma and an acute upper respiratory infection, contracted after leaving the hospital, have retarded his complete recovery. However, his former abdominal complaints have largely disappeared and he is well satisfied with his immediate postoperative result.

CONCLUSIONS

The fifth recorded instance of a carcinoid tumor occurring in a Meckel's diverticulum is reported. The patient had signs and symptoms simulating those of a chronic peptic ulcer. Data pertaining to the other four cases previously reported are tabulated. Theories as to the origin of carcinoid tumors of the gastrointestinal tract are summarized. Four photographs reveal the gross and microscopic appearance of this specimen.

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CAROTID BODY TUMORS

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CAROTID body tumors, long considered as one of the rarer tumors encountered, have been reported in the literature with increasing frequency during the past decade. There are few pathologists and surgeons in active services who have not met with, or heard of one or more of them, yet not many take the time and trouble to record their observations and opinions. This report is offered as a critical review of the literature with the addition of cases of our own. All four of the cases included herein were operated upon by one of us (H. K. S.) in Grace and Receiving Hospitals in Detroit.

Graham,[1] in 1912, was one of the first to review critically the literature of reported cases. In 1929, Bevan and MacCarthy[2] surveyed the literature to date and assembled 134 cases. Rankin and Wellbrock[3] in 1931 reported twelve cases from the Mayo Clinic. In 1933, E. I. and J. M. Green[4] were able to find 196 cases. Since then, reports by Abbott and Stevenson,[5] Chance,[6] Chase[7] Picard and Laduron,[8] Ninger,[9] Bertrand and Sauvage,[10] Cragg[11] and others have added cases. Peterson and Meeker,[12] in reporting eighteen cases operated upon by members of the New York Surgical Society, and including cases seen at the New York Post-Graduate Hospital, state that a cursory review of the literature reveals only 230 cases.

According to Stewart,[13] von Haller in 1743 was the first to mention the carotid body, Newbauer in 1786 the first to describe it; Luschka in 1862 worked out the anatomy and histology. It is said that Reigner in 1880 operated upon the first recognized carotid body tumor and Middleton in 1895 was the first American to do the same.

The carotid body is a paired organ described as being the size of a grain of wheat and as measuring $5 \times 3 \times 1.5$ mm. Many names have been given to it, such as carotid gland, globus caroticum, glomus caroticum, ganglion intercaroticum, paraganglia caroticum, glandula carotica and intercarotid nodule. Sometimes it is considered to be a ganglion, sometimes a gland of internal secretion.

Its most frequent situation is on the median and deep side of the upper end of the common carotid artery, in close relation with the point of division of the latter vessel into the external and internal branches. It lies not within the bifurcation, but rather on the common carotid artery, so that its form and relation are best displayed by dissection from within outward. It is pinkish-gray in color. Sometimes it consists of two unequal divisions, which are united below. It is intimately connected with the periarterial sympathetic plexus and receives a branch of the glossopharyngeal nerve.

The carotid body is first seen in embryos of 19 mm. (six weeks). The usually accepted theory of development is that the chromaffin cells are derived from the superior cervical ganglion and from the cranial sympathetic ganglion through the ninth and tenth cranial nerves, and that the mesodermal constituents are derived from the third branchial arch. A second theory is that it is derived in entirety from the third or fourth branchial cleft. The third theory is that it is derived from the "perithelium" of the carotid artery. It

reaches full development between twenty and thirty years and remains stationary for a period, after which the interlobular vessels thicken and sclerosis and atrophy of the organ result.

Microscopically, the carotid body is composed of a framework of highly vascular connective tissue, which supports spheroidal groups of epithelial cells with poorly defined boundaries, closely associated with tufts of capillaries. These capillaries are thin walled, large in diameter, and sinusoidal in character.

Stewart[13] made a number of original and quite interesting observations in this field. He describes two types of cells which he designates as "A" and "B." "A" cells are large and polyhedral, rich in cytoplasm which stains poorly and is finely granular, and form somewhat of a syncytium. The nuclei are large, round or oval, somewhat eccentric, rich in chromatin, and show a nuclear membrane. Other cells closely resembling them are found, which are slightly larger, with less granular cytoplasm, and containing small vacuoles. The "B" cells he believes to be endothelial; these are found around the periphery of the lobules. They are small or medium sized, have little cytoplasm, and deep staining nuclei which are oval or spindle-shaped. He observed, occasionally, a few scattered eosinophiles.

The physiology of the carotid body has not been satisfactorily worked out. For many years, it was generally accepted as part of the chromaffin system. This theory has been strengthened by the recent report of Cragg,[11] in which he described a case of carotid body tumor which was accompanied by tumors of the Zuckerkandl bodies. De Castro[14] produced evidence that the carotid body does not contain epinephrine; he suggested a relationship to the carotid sinus, an opinion which Heymans[15] supports. Frugoni (quoted by Nix and D'Aunoy[16]) does not believe that there is any internal secretion. Bilateral extirpation has been done without any untoward symptoms. The case reported by Nix and D'Aunoy had hypertension, which decreased after removal; the authors gave no opinion as to the cause, but stated that they did not believe the drop in blood pressure was occasioned by the removal. In one of Stewart's[13] cases syncopal attacks occurred. Needles[17] also observed a case in which there were syncopal attacks.

Infections of the carotid body have not been described. The occasional eosinophilia described in the normal gland by Stewart[13] may be infectious in origin.

The only pathologic change described is that of tumor formation. Sullivan and Fraser[18] classify the tumors into two groups. The first group, by far the most common, resembles closely the normal gland structure. The second group includes those described by various authors as sarcoma, sarcoma-like, pseudosarcoma, endothelioma and perithelioma, the multiplicity of the names suggesting to Sullivan and Fraser the uncertainty of origin. They believe that some of the histologic pictures represent different stages of cell maturation in another line of differentiation of the neural crest epithelium from which the sympathetic nervous system is derived; e.g., neuroblasts giving rise to neuroblastomas or capsule cells, or perhaps Schwann sheath cells giving rise to neuroblastoma-like tumors with true ganglia cells or axis cylinders. They conclude that the tumors are neuroblastomas, or at least varieties of neuromas, and not tumors of fibroblastic or endothelial origin; hence the names of ganglioneuroma, paraganglioma, chromaffinoma, neuroblastoma.

Ewing[19] considers carotid body tumors to be a variety of perithelioma, which consideration he bases on their morphology. It must be remembered also that where there is fascia, connective tissue tumors may arise, and that where there are blood vessels, vascular tumors may arise.

The nosology of carotid body tumors will remain in doubt until the embryology and physiology are better understood than at present.

There has been only one instance of multiple cases of carotid body tumors in a family. Chase[7] reported two cases in sisters; one was bilateral and occurred at the age of twenty seven; the other was unilateral and occurred at the age of twenty eight.

The general clinical features have been worked out in detail by Bevan and MacCarthy.[2] They found that 70 per cent of the cases occurred in the forty to sixty year age group, with an average of forty-two years, although cases have been described in the very young and the aged. The sexes are affected about equally. The important finding is a tumor. In but two cases did they find metastases to neighboring lymphatic nodes reported. Secondary generalized effects, such as anemia or cachexia, do not exist unless there are metastases. In two cases syncopal attacks have occurred, which suggests involvement of the carotid sinus.

Carotid body tumors, in spite of their rarity, are extremely important because they arise in the neck, and present themselves in the same general area as do so many other tumors and swellings. However, carotid body tumors usually can be diagnosed before operation, especially where the external carotid artery is seen or felt over the outer surface. Another important physical finding and one which is almost pathognomonic of carotid body tumors, is radial mobility and longitudinal fixation. This is because of the intimate association with the carotid arteries.

Greene and Greene[4] suggest that attempted aspiration, injection of opaque media and punch biopsy may be of great aid in differentiating carotid body tumors from branchiogenic cysts. We agree with the possibility, but there is ever a source of danger in the close proximity of the carotid arteries, the position of which cannot be determined without dissection.

There are no other available laboratory or *x*-ray methods which directly aid in diagnosing carotid body tumors. From the standpoint of ruling out other conditions, general diagnostic procedures, such as a tuberculin test, a complete blood count, serologic test for syphilis and flat plate *x*-ray should be done routinely.

There is considerable discrepancy in the literature concerning the treatment. Bevan and MacCarthy[2] insist that *x*-ray therapy should be used if the diagnosis is made. They are supported in their contention by the morbidity and mortality which follow ligations of the common carotid arteries. However, few cures have been reported by *x*-ray. Stewart[13] thinks that radium is of little value and quotes Birman, who gives the same opinion. Nix and D'Aunoy[16] believe that surgery is the method of choice and that it should be supplemented by *x*-ray or radium. Joyce and Diack[20] favor ligation of the common carotid artery. In our own experience, surgery alone has proven quite satisfactory.

CASE REPORTS

Case 1. H. W., a white boy, age 15, entered the Detroit Receiving Hospital on July 5, 1921, with the complaint of a tumor beneath the angle of the right jaw. The mass was first noticed two months before. At that time, he was unable to open his mouth widely and he had some pain in the jaw region when such an attempt was made. He had had no sore throat. At the time of onset, there was some watery discharge from the right ear. The boy and his mother based the condition on a blow from a baseball bat upon the left occipital region eight months before. During the two months before admission, he had had the tumor incised and drained twice under the supposition that acute cervical adenitis or tuberculosis was present. Neither time was tissue taken for microscopic pathologic examination. Subsequently the tumor increased in size.

On examination, a mass measuring approximately $5 \times 4 \times 3$ cm. was present below the angle of the right jaw. There was a scar of previous operation along the anterior border of the upper part of the right sternocleidomastoid muscle. There was a point of tenderness just below the ear. The cervical lymphatic nodes were palpable on the right side below the tumor, and still larger glands were felt

beneath the other angle of the jaw. The patient could open his mouth about one-half the normal distance freely and without pain, further opening seemed to be impossible. Other points in the examination revealed normal eye grounds and pupils. The protruded tongue deviated to the left. There were no other neurologic abnormalities. Roentgen examination failed to reveal fracture of the skull or any signs of ankylosis of the right jaw.

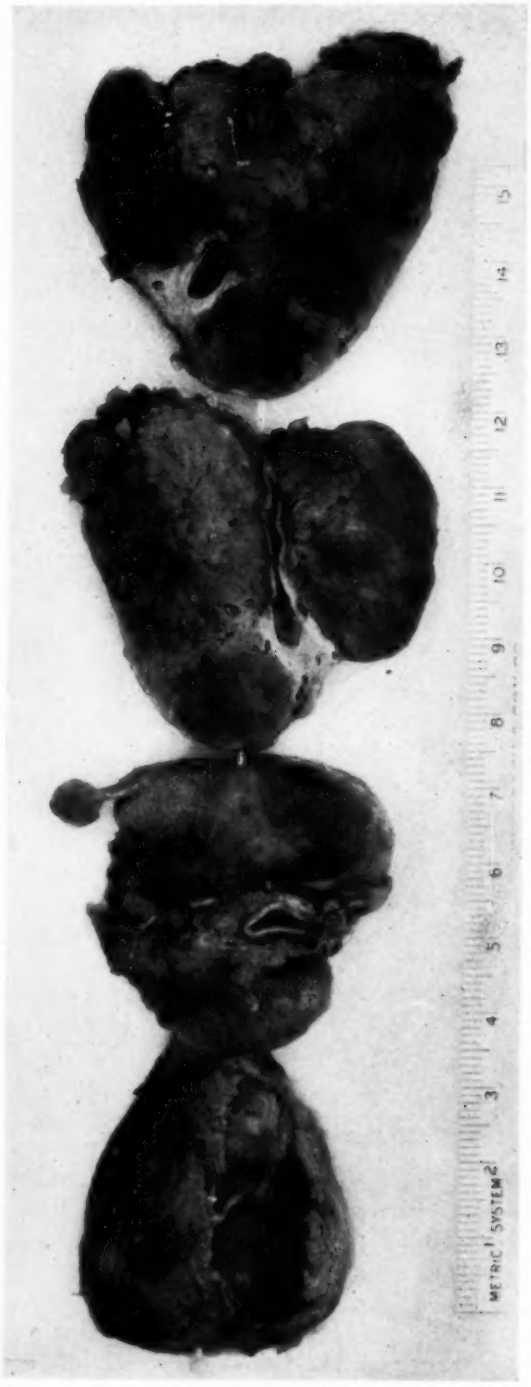

Fig. 1. Case 11. Transsection of the tumor in the gross at different levels and all specimens transfixed on a long needle. The carotid body tumor has surrounded and compressed the common carotid artery and its branches.

Fig. 2. Case 11. Photomicrograph, showing the large blood spaces and the parenchymal cells between.

On July 8, 1921, a third operation was performed. This consisted in removal of a tumor from the region of the bifurcation of the right carotid and a bloc excision of the upper right lymphatic glands off the carotid packet. A portion of the sternocleidomastoid muscle and the lower tip of the parotid gland were included in the resection.

Pathologic Report. This report was made by Dr. Plinn F. Morse, who stated the tumor to be a perithelioma of the carotid body with infiltration of the lymph nodes. The patient was discharged from the hospital eight days after the operation.

There are no available photographs, photomicrographs or follow-up of the case.

Case 11. J. E., age 52, was admitted to the Detroit Receiving Hospital on August 21, 1933, complaining of a swelling below the angle of the right mandible, of twenty years' duration. The swelling had slowly and progressively increased in size. Of late, it had become tender and was painful during cold weather.

There was a large mass in the upper portion of the right side of the neck. It could be moved from side to side, but not up and down.

It appeared to be attached to the sternocleidomastoid muscle and somewhat in turn to the overlying skin. No pulsation was made

Fig. 3. Case II. Showing the oblique skin plane incision used in all but Case III, in which an incision was made parallel to the anterior border of the sternocleidomastoid muscle.

out. It was slightly tender. There were no pupillary changes.

On August 22, 1933, this tumor was removed along with adjacent infiltrated tissues. The growth was found to be at the bifurcation of the carotid and completely surrounding the three vessels. The right common carotid artery with its external and internal branches, the internal jugular vein, the vagus nerve, the hypoglossal nerve and its descending branch, and a portion of the sternocleidomastoid muscle were all infiltrated and had either to be divided or resected in order to remove the tumor. The recurrent laryngeal and superior sympathetic nerves were divided. The arteries surrounded by and distal to the tumor were markedly diminished in size. This was probably due to compression of the growing infiltrating mass. Except for hoarseness, he made an uneventful recovery. Subsequent examinations showed that the seventh, ninth, tenth, eleventh, twelfth and the cervical sympathetic nerves had been interfered with. No brain involvement occurred.

He has been seen from time to time after leaving the hospital. (Fig. 3.) Forty months after operation, there had been neither general nor local recurrence. The nerve involvements stated above remained about the same, except

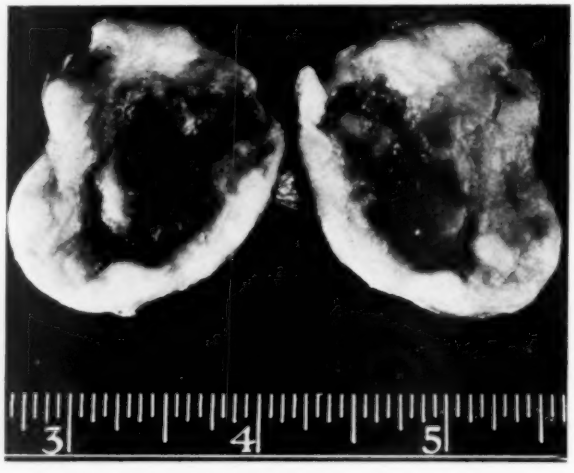

Fig. 4. Case III. Photograph of gross specimen, bisected.

that the facial nerve injury proved to be a temporary one. The hoarseness, enophthalmus, ptosis of the eyelid and contraction of the left pupil were much less noticeable. In fact, this patient states that he can see better with the involved eye than he can with the opposite one.

Pathologic Report. Dr. O. A. Brines made the following report: "In the gross, the specimen is an irregular oval shaped mass, weighing 60 Gm. and measuring 5.5 cm. in maximum diameter. (Fig. 1.) The mass contains a portion of the external jugular vein at the anastomosis of one of its tributaries. On section, the tissue is soft and friable and deep yellowish pink in color in the fresh state.

"Microscopically, the sections represent new growth tissue and the various areas show practically no variation in cell morphology. (Fig. 2.) The neoplastic cells are fairly large with light staining acidophilic cytoplasm. The nuclei are deep staining and there is a considerable variation in the size and staining intensity of the nuclear material. These cells are arranged in small masses separated by large capillaries. In some areas there is abundant blood pigmentation. This tissue possesses very little stroma and there is only a slight amount of necrosis. One section contains a large artery. Diagnosis—Carotid body tumor."

Case III. The subject was a white female, age 36, who was admitted to Grace Hospital August 2, 1934, referred by Dr. J. P. Buchanan. She first noticed a swelling below the angle of

the jaw several years before, following the extraction of several infected teeth. It decreased in size under iodine therapy but remained present for several years. For the previous three years, it had slowly increased in size and for several months before operation, she had a little pain and discomfort. There was some limitation of motion of the head due to the size of the swelling.

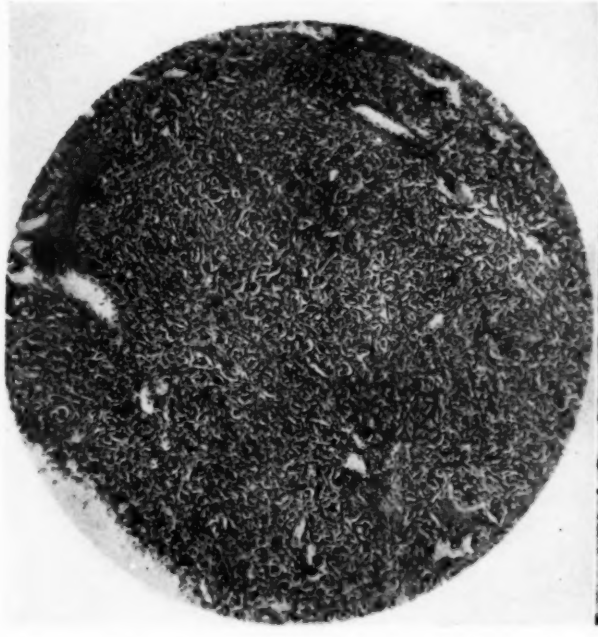

Fig. 5. Case III. Low power. Note the alveolar architecture and the fine connective tissue trabeculation.

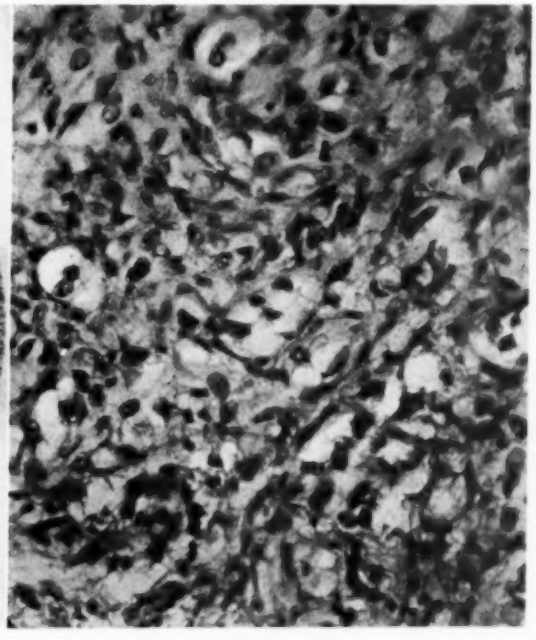

Fig. 6. Case III. High power. Note the sinusoidal arrangement and the vesiculation of the tumor cells. Note also the variation of the size of the nuclei.

Examination showed a firm, rounded swelling below the angle of the jaw, and anterior to the sternocleidomastoid muscle. It extended under this muscle and displaced it forward. It was not tender and the skin was freely movable over the mass. There was a pulsation and bruit present. The surface of the swelling was smooth and elastic. No fluctuation could be elicited. The remainder of the physical examination was negative.

The blood Wasserman was negative. The blood and urine were normal. Von Pirquet tuberculin test a week before the operation was negative. The blood pressure had never been observed to be abnormal and at the time of operation was 118/72.

On August 2, 1934, the tumor was removed surgically under combined local and general anesthesia. The common carotid artery and both of its branches were ligated.

Postoperatively, there was a slight temporary facial paralysis, a temporary tachycardia and a temperature of 100 degrees for three days. Twenty-nine months after the operation, she was perfectly well. No hemiplegia, even transitory, such as is common with carotid artery ligations, developed.

Pathologic Report. "The tumor removed at operation weighs 28 Gm., is firm in consistency and is encapsulated. On gross section it cuts easily, and yields no tissue when the surface is scraped with a knife. It is yellow-white about the periphery and is red and highly vascularized in the center. (Fig. 4.)

"Microscopically it is composed of a framework of fibrous tissue which is hyalinized in some areas. This varies in amount throughout the tumor, in some places being almost absent and in others quite abundant. In those areas where it is most abundant, it contains many capillaries, which in some areas are almost sinusoidal in character. The tumor cells proper are arranged in poorly formed alveoli, which in some areas are separated by connective tissue trabeculae and in other areas are in almost solid masses with fibrillar stroma. The cells are perithelial appearing, have poorly defined cell borders. The cytoplasm is pale, slightly granular in some cells and vaculoated in others. The nuclei stain lightly, have a reticular framework and distinct borders.

Both cells and nuclei vary considerably in size and in staining. There are a number of small, round and plasma cells throughout the tumor,

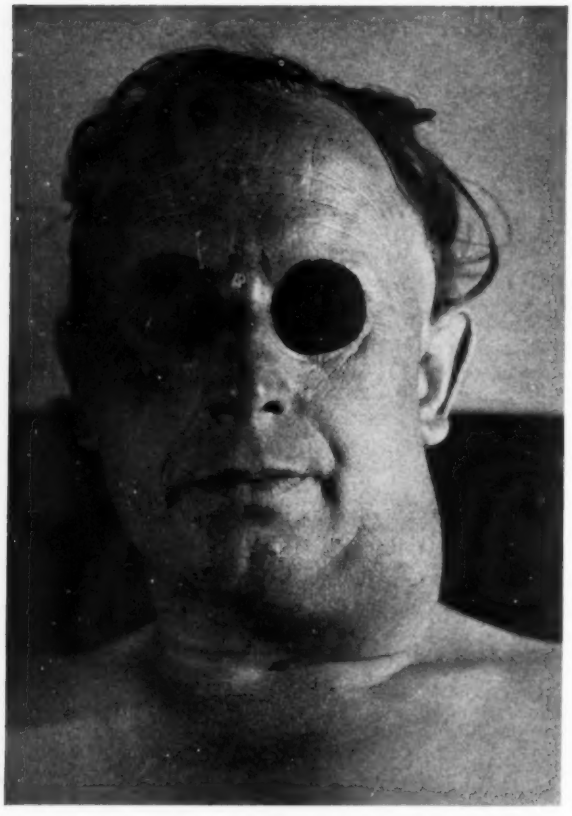

Fig. 7. Case iv. Showing a large carotid body tumor on the left side of neck.

some in localized areas and others scattered diffusely. (Figs. 5 and 6.)

"Diagnosis: Carotid body tumor."

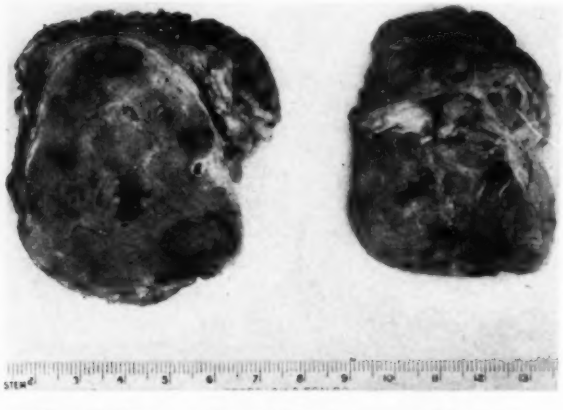

Fig. 8. Case iv. Carotid body tumor, bisected.

Case iv. E. W., age 40, entered the Detroit Receiving Hospital on September 24, 1935, with the complaint of a large mass in the upper part of the left side of the neck. He had noticed it first as a rather hard mass, about 2 cm. in diameter four years before. This grew rapidly for two years, at which time

Fig. 9. Case iv. High power. Photomicrograph showing alveolar architecture.

it reached the present size. It had never caused any symptoms.

There was a large, rather soft, egg-shaped tumor located on the left side of the neck, below and behind the left ear. It was about 8 cm. in diameter and the sternocleidomastoid muscle passed over the central area. The tumor was not tender, not adherent to the skin, and could be moved from side to side, but not in the vertical direction. (Fig. 7.) While there was no expansile pulsation of the tumor, a pulsation could be seen over its surface, suggestive of an artery. The laboratory analysis was essentially negative except for strongly positive serologic findings.

On September 27, 1935, the tumor was removed. The external carotid artery was flattened out over its surface. Along with the encapsulated tumor, the common carotid artery with its branches, the internal jugular vein, the vagus nerve and the descending branch of the hypoglossal nerve were resected. Except for injury to the hypoglossal nerve, recovery was uneventful. There was no recurrence a year and a half after operation.

Pathologic Report. Dr. O. A. Brines reported the pathology as follows: "The gross specimen is a somewhat irregular, oval shaped tumor which is apparently encapsulated and measures 7 cm. in length, 5.5 cm. in width and 4.5 cm. in thickness. There is considerable fascia attached to the capsule. The external jugular

vein runs through one edge of the mass. The specimen weighs 90 Gm. (Fig. 8.) On section the color is somewhat mottled with dark brown areas on a pink-gray background. In the center there is an area of liquefaction necrosis.

"Microscopically, the sections represent a solid neoplasm composed of fairly large cells with pale staining cytoplasm, which is slightly basophilic. These cells possess oval shaped nuclei, which have a fairly high chromatin content and are quite uniform in size and staining intensity. These cells are arranged in small groups and the individual cells in these groups are not well defined. The tissue is exceedingly well vascularized and the cell clusters are invariably separated from each other by capillaries, which are usually widely dilated. Due to this vascular distribution, all of the cells are in close proximity to capillaries. There is a thick capsule and wide fibrous trabeculae. The tumor contains large thick-walled blood vessels, most of which are veins. In some areas, there is a generous deposit of blood pigment, suggesting a previous hemorrhage. In some areas, there is considerable fibrosis and hyaline replacement of the tumor parenchyma. In the fibrous tissue, there is a perivascular infiltration of lymphocytes. (Fig. 9.)

"Diagnosis: Carotid body tumor."

SUMMARY

1. Four cases of carotid body tumor subjected to surgical removal are reported.

2. Three were in men and one in a woman and their ages were respectively 15, 52, 36 and 40 years.

3. The tumors were of two months', twenty years', three years' and four years' duration. That they may exist for years without complications is illustrated by the second case. This brings up the question of radiation treatment.

4. A correct preoperative diagnosis was made in three cases and during operation in the fourth.

5. Two tumors were encapsulated and two had infiltrated the surrounding tissues.

6. The carotids were ligated once and resected twice. The tumor was removed once without injury to th evessels.

7. The facial nerve was temporarily injured twice. The right vagus nerve was resected three times. The spinal accessory was injured twice, the hypoglossal twice and the cervical sympathetic nerve once.

8. No case at any time had hemiplegia.

9. None received preoperative, and but one postoperative *x*-ray therapy.

10. There were no deaths and no recurrences respectively forty, twenty-nine, and fifteen months after operation. One case could not be traced.

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CHROMARGENTAFFINE TUMORS OF THE APPENDIX

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IN a series of 4,224 appendices examined at our surgical pathologic laboratory in the last four years, we have diagnosed five cases of carcinoid which we report with special reference to their clinical behavior and ultimate course.

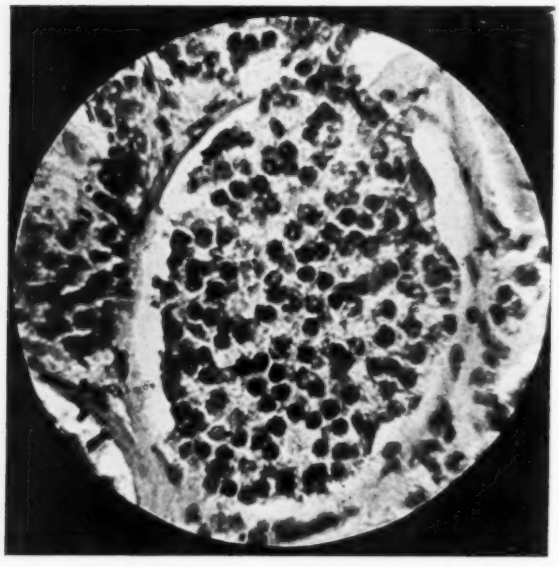

FIG. 1. Case 1. Nest of cells with granular cytoplasm, small spheroidal uniform nuclei.

CASE I. (Service of Dr. M. Fellman.) Mrs. M. H., 45, white, entered the hospital August 1932, because of profuse vaginal bleeding of four days' duration. Her past history included the usual childhood diseases. She had three children alive and well, and had had her menopause in July 1931. Vaginal bleeding began in January 1932, lasted two days, and had been intermittent since then. Dull backache had been present for three years, but recently had been more noticeable. Her appetite was good, and there was no loss of weight.

Physical examination was essentially negative. Pelvic examination showed the cervix and introitus to be normal and a uterine polyp protruded from the cervical canal. The uterus was free and movable, but nodular.

Laboratory Findings. There was a slight secondary anemia. Otherwise the findings were negative.

Operation. On August 10, 1932, a supravaginal hysterectomy and appendectomy were performed. The course was uneventful with ultimate complete recovery.

Gross Pathology. The uterus showed intramural and subserous fibromata and a uterine polyp. The appendix measured 6 cm. in length and varied from 0.5 to 1.3 cm. in diameter at its tip. The serosa was smooth and shining. On section, the distal fifth of the lumen was obliterated by a firm, resilient, bright yellow nodular mass, measuring 0.9 cm. in its largest diameter.

Microscopic Description. Sections showed hypertrophic anastomosing strands of partially hyalinized stroma supporting nests and clusters of cells with granular cytoplasm and indefinite pericellular membranes. The nuclei were round or spheroidal, rather uniform and heavily dotted with chromatin material. The muscularis and serosa were invaded and infiltrated, but always separated from the tumor by narrow or broad bands of hyalinized stroma. Sections stained by silver impregnation showed an affinity of the cytoplasm granules for silver.

Diagnosis. Argentaffine tumor of the appendix.

Comment. The outstanding feature of this case is that the tumor was an incidental finding. The tumor was single and the patient is well to date.

CASE II. (Service of Dr. E. Burke.) Mrs. H. S., 44, white, was admitted to the hospital in September 1933, with a diagnosis of umbilical and right inguinal hernia. Past history included the usual childhood diseases, and the delivery of two children, now alive and well. The umbilical hernia appeared following the delivery of a healthy baby twenty years ago; three months previous to admission, the patient

noticed an enlargement in the right inguinal region. Laboratory findings were within normal limits.

Comment. This case is like that preceding. The patient is well to date.

Case III. (Service of Dr. M. Fellman.)

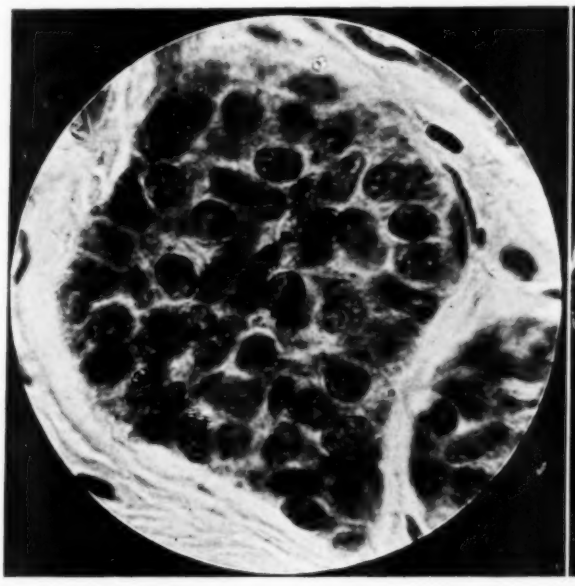

Fig. 2. Case II. Oil immersion magnification. The peripheral cuboidal or columnar cells have eccentrically placed, spheroidal or elongated nuclei. The cytoplasm is profuse and finely granular.

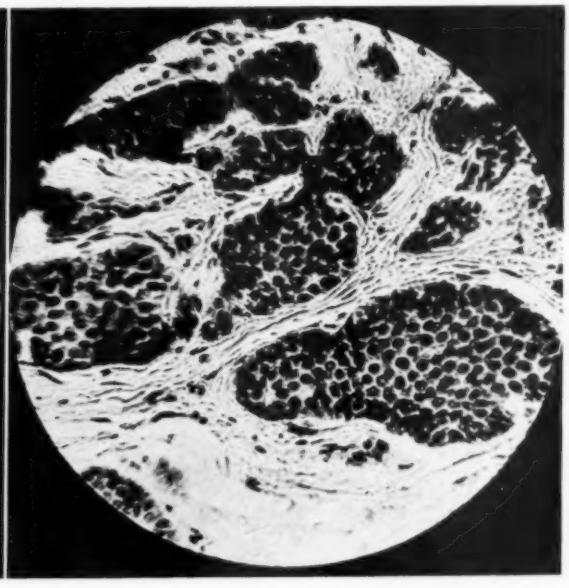

Fig. 3. Case II. Low magnification.

Operation. On September 8, 1933, repair of the right inguinal and umbilical hernias and a prophylactic appendectomy were performed.

Gross Pathology. The specimen received at the laboratory was an appendix measuring 6 cm. in length and 0.5 cm. in diameter. The serosa was smooth. On section, the wall was thickened and the lumen near the tip was obliterated by a yellowish mass 0.4 cm. in largest diameter.

Microscopic Description. Sections of the appendix showed a diffuse hyperplasia of the stroma, which was occasionally hyalinized and in which were cords or clusters of cells. These had uniform round nuclei devoid of any mitotic figures. The cytoplasm was finely granular and slightly neutrophilic. At the periphery the cells assumed a low columnar or cuboidal shape with round or elongated eccentrically placed nuclei. The muscularis and serosa were not involved and were sharply limited from the tumor by a thick partially hyalinized stroma. Silver impregnation shows the granules of the cytoplasm to be stained by silver.

Diagnosis. Argentaffine tumor of the appendix.

Miss T. D., 21, white, was admitted to the hospital April 16, 1934, because of pain in the right lower quadrant of forty-eight hours' duration. Her past history included a tonsillectomy at the age of 6 and rheumatism as a child. The present history began two days previous to admission with sudden onset of "knife-like" pains in the epigastric region, which one-half hour later, shifted to the right lower quadrant. The patient had some nausea but no vomiting.

Physical Examination. The patient appeared toxic. The lungs were negative. There was marked enlargement of the heart to the left; the maximal impulse was at the fifth interspace, 14 cm. left of the midline. There was a presystolic thrill over the whole apex; a rough systolic and crescending diastolic were noted in the same areas. The pulmonary sounds were louder than the aortic; the sounds were of fair quality. The right side of the abdomen was firm and rigid. Deep pressure at the right lower quadrant produced marked pain.

Laboratory Findings. There was a leucocytosis, with 80 per cent polymorphonuclear leucocytes. Otherwise the findings were negative.

Operation. On April 16, 1934 an appendectomy was performed under spinal anesthesia.

The course was uneventful with ultimate complete recovery.

Gross Pathology. The appendix measured 9 cm. in length and varied in diameter from 0.7 to 1.3 cm. The serosa was covered with a fibropurulent exudate. On section, underneath the mucosa there was a bright yellow single nodular mass 0.8 cm. in diameter. The lumen was patent but narrowed.

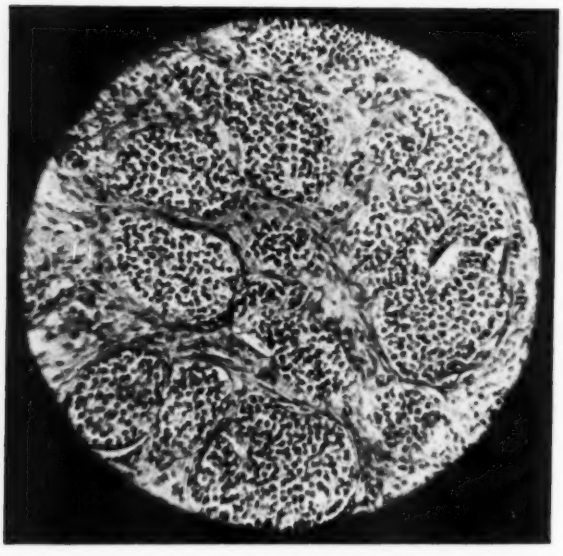

Fig. 4. Case III. Nest of cells separated by strands of partially hyalinized stroma. The nuclei are uniform and moderately dotted with chromatin.

Microscopic Description. Within the submucosa were groups and strands of cells with uniform round nuclei moderately dotted with chromatin but devoid of mitosis. The cytoplasm was quite granular and the cellular membranes indistinct. The crescent-like mucosa was atrophic and the lumen narrow. The stroma was partially hyalinized and more abundant at the periphery of the tumor. The muscularis was atrophic and infiltrated. The serosa was devoid of neoplastic involvement. The entire wall was diffusely spotted with polymorphonuclear leucocytes, with marked edema and congestion. Silver impregnation showed the granules of the cytoplasm to be stained by silver.

Diagnosis. Acute suppurative appendicitis. Argentaffine tumor of the appendix.

Comment. This case presented a typical history of appendicitis. The patient is well to date. The case was complicated by a rheumatic heart.

Case IV. (Service of Dr. M. Fellman.) Miss A. L., 19, white, was admitted to the hospital February 10, 1935 because of pain in the right lower quadrant. The patient had been in good health except for occasional "abdominal cramps" of one year's duration. A month before, the patient had been seized with mid-epigastric pain which later localized in the right lower quadrant and lasted two days, after which she felt well until the night before admission, when the same symptoms, in more severe form, recurred, accompanied by nausea and vomiting. The past history was otherwise essentially negative.

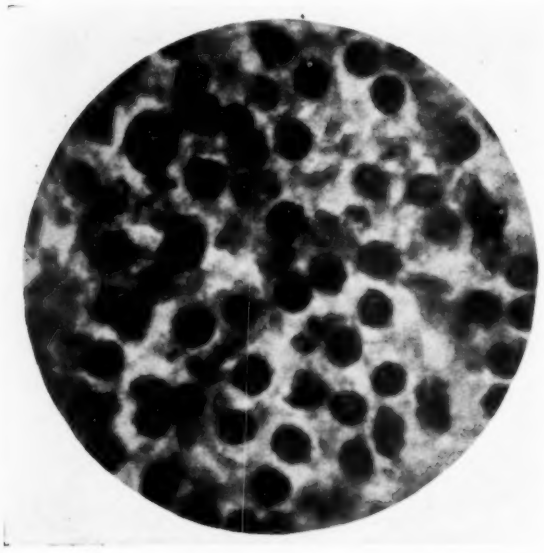

Fig. 5. Case IV. The nuclei are round, even and heavily dotted with chromatin; the cytoplasm is granular and without demonstrable pericellular membrane. Oil immersion magnification.

Physical Examination. The abdomen was soft, without rigidity. Tenderness was present in the right lower quadrant without any rebound tenderness.

Laboratory Findings. The white cell count was 10,250, with 76 per cent polymorphonuclear leucocytes.

Operation. An appendectomy was performed. Complete recovery followed an uneventful course.

Gross Pathology. The appendix measured 6 cm. in length and 0.5 cm. in diameter. The serosa was smooth, but the blood vessels were congested. Beneath the submucosa, near the tip of the appendix was a bright yellow, freely movable resilient nodule measuring 0.5 cm. in largest diameter. The overlying mucosa was

forced into the lumen to approach the opposite wall.

Microscopic Description. Sections of the appendix showed clusters and nests of spheroidal cells separated by hypertrophic partially hyalinized bands of fibrous tissue. The nuclei were uniform, round and heavily dotted with chromatin. There were no demonstrable mitotic figures. The cytoplasm was granular; the pericellular membranes were not demonstrable. The muscularis and serosa were uninvolved and were separated from the tumor by an excess of hyalinized stroma. The entire section was congested, edematous and moderately sprinkled with polymorphonuclear leucocytes and lymphocytes. The granules of the cytoplasm showed affinity to silver.

Diagnosis. Acute appendicitis. Argentaffine tumor of the appendix.

Comment. This is a typical case of acute exacerbation of an old appendicitis associated with chromargentaffine tumor.

Case v. (Service of Dr. W. Friele.)

Clinical Features. Mr. P. L., 27, white male, was admitted to the hospital June 2, 1936. For the preceding three years, he had had epigastric pain immediately after eating; this pain was relieved by baking soda or vomiting. In the summer of 1935, he consulted a physician, but treatment did not yield improvement. One year later, after eating, the patient noticed pain stronger than usual. It remained in the right upper quadrant for two days, then settled in the right lower quadrant and became more severe. No nausea was present. Tenderness just to the right of the rectus muscle above the symphysis pubis was noted, and there was slight rigidity of the right rectus muscle.

Laboratory Findings. The stools were negative for occult blood. There was slight leucocytosis with 76 per cent polymorphonuclear leucocytes.

Operation. On June 20, 1936 the patient underwent an appendectomy, recovered completely and uneventfully.

Gross Pathology. The appendix measured 5 cm. in length and varied from 0.6 to 1 cm. in width. The serosa was smooth with congested blood vessels. On section, the lumen appeared occluded by a bright yellow, nodular mass 0.6 cm. in largest diameter.

Microscopic Description. Sections of the appendix showed a partially hyalinized stroma invaded by clusters, cords or anastomosing masses of closely related polygonal cells with abundant, moderately eosinophilic, finely granular cytoplasm. The nuclei were round or oval with conspicuous perinuclear membranes, and were delicately dotted with chromatin material. The pericellular membranes were indistinct. The muscularis was atrophic and sharply separated from the tumor by a conspicuous amount of stroma. Scattered throughout were polymorphonuclear leucocytes, monocytes and lymphocytes. Silver impregnation showed an affinity of the cytoplasmic granules for silver.

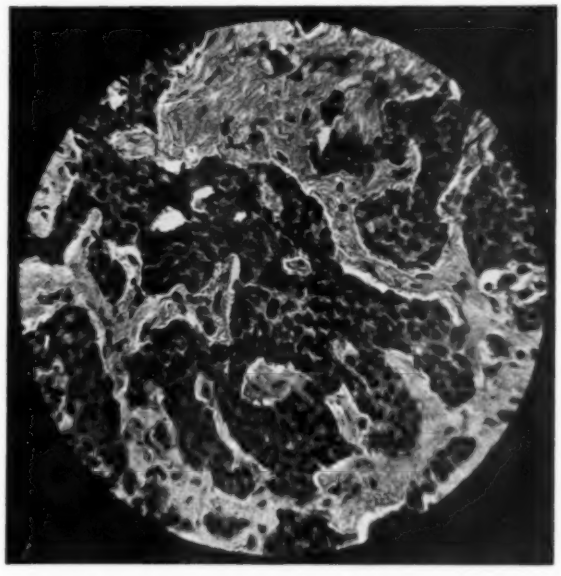

Fig. 6. Case v. Low magnification. Polygonal cells with finely granular cytoplasm, closely simulating epidermoid cells.

Diagnosis. Acute appendicitis. Argentaffine tumor of the appendix.

Comment. The history was suggestive of peptic ulcer, but observation and radiographic detail pointed to appendicitis.

CONCLUSIONS

1. These tumors cannot be clinically diagnosed. They are merely incidental findings or are associated with chronic or acute appendicitis.

2. The innocence of carcinoid of the appendix is a conspicuous feature, even in the presence of serosal involvement, if the tumor is removed in toto. (All the patients are alive and well.)

3. These tumors are believed to arise from the chromargentaffine cells distributed in the stomach and intestines, especially in the appendix.

4. In our cases, multiplicity of the tumors was not noted.

I wish to thank Drs. E. Burke, M. Fellman and W. Friele for allowing me to abstract the cases.

THE various causes [of eventration of the diaphragm] are: congenital atrophy, dystrophy, neuromuscular degeneration following injury, neuritis or other involvement of the phrenic nerve or its fibers, certain infectious diseases and changes in the musculature of the diaphragm, such as pseudo-hypertrophic lipomatosis and myositis.
From—"Surgical Diseases of the Chest" by Evarts A. Graham, Jacob J. Singer and Harry C. Ballou (Lea & Febiger).

JEJUNAL ULCER FOLLOWING GASTROENTEROSTOMY*

RESULT AFTER TWO YEARS

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H. K., aged 42 years, was admitted to the Surgical Service of the Lenox Hill Hospital on July 31, 1934, complaining of pain in the lower abdomen, radiating from the right to the left side, at times cramp-like in character, and occasionally accompanied by distention.

The patient had had a gastroenterostomy performed for a duodenal ulcer at another hospital in 1929, and an appendicectomy in 1932. The history as of 1929 was typical of a duodenal ulcer without, however, any hematemesis or melena. In the ten months previous to his operation, he had been treated medically but in spite of this lost 27 pounds. Immediately following the gastroenterostomy, he had some relief, but then began to be aware of a "dragging and annoying" feeling across his lower abdomen. This persisted, and in 1932, the appendectomy was done, although there were not, in his opinion, any symptoms referable to the appendix.

The patient dated the onset of the symptoms present at the time of his admission to Lenox Hill Hospital from the time of the gastroenterostomy. The dragging pain across the lower abdomen, which was not relieved by the appendectomy, became about July 1, 1934 more severe and cramp-like in character. It was not related to meals and was noticed particularly at night. Distention and belching were associated with it. High colonic irrigations were resorted to without benefit. The patient stated that, preceding relief from the attacks, he could feel something that seemed to slide over some obstructing object in his bowels, and that the movement seemed to be from left to right.

On July 29, 1934, following a very severe attack of pain that lasted from ten o'clock in the evening until two o'clock in the morning, he vomited and was relieved. His physician then recommended hospitalization.

Physical examination revealed a rather undernourished man of 40 of the asthenic type. The lungs and heart were normal. The abdomen was slightly distended, and somewhat tender throughout, with tenderness most pronounced just to the left of the umbilicus.

Wassermann and urine examinations were negative. The blood picture was of no special significance except for a slight secondary anemia with a hemoglobin of 70 per cent. Test meals showed hyperacidity, the free hydrochloric acid before and after the meal being 40 and 68, and the total acidity 55 and 84 respectively. No blood was found.

Roentegenographic examination of the gastrointestinal tract showed a stoma on a high level and the pyloric half of the stomach dilated and atonic because it could not empty through the stoma. The first portion of the duodenum was not satisfactorily outlined at any time and none of the barium was seen to leave through the pylorus. A diagnosis of chronic duodenal ulcer and probably chronic marginal ulcer was made.

On August 8, 1934, an operation was done with the preoperative diagnosis of gastrojejunal ulcer. On entering the abdominal cavity many adhesions were found, especially of the omentum to the anterior abdominal wall. After these were separated, the jejunum was found to be anastomosed high up on the posterior wall of the stomach. Further examination revealed a rather firm, indurated mass with ulceration at the site of the anastomosis adherent to the colon. In attempting to separate the jejunum from the adherent colon, the indurated and scarred tissue was torn, causing a small perforation of the jejunum at the site of the ulcer. The mesocolon was then dissected away and the lesser peritoneal cavity entered. An examination of the pyloric end of the stomach and the duodenum revealed no evidence of previous ulceration. As there appeared no valid reason

* Presented before the New York Surgical Society, November 11, 1936.

why the normal relationship should not be restored, the gastroenterostomy stoma was resected and the opening in the stomach was closed.

Upon examination of the jejunal loop containing the ulcer, it was seen that a simple closure together with an excision of the ulcer could not be done. Therefore, about 5 inches of the jejunum were resected and an end-to-end anastomosis was done. The mesentery and the rent in the mesocolon were closed, and the abdomen was closed in layers.

The pathologic report of the specimen showed an ulcerated area 2 cm. in diameter near one edge of the opening which had been the stoma. The crater-like floor was covered by granulation tissue. The pathologic diagnosis was chronic ulcer of the small intestine.

In December of that year (1934) the patient stated that he was in excellent health, able to eat and drink everything without discomfort, and that he had gained 30 pounds. He has remained well up to the present time.

The case is presented to show: (1) the inadvisability of doing a gastroenterostomy in the presence of a florid ulcer of the duodenum; (2) that an improperly placed stoma which prevents an easy emptying of the stomach can lead to serious complications; (3) that the diagnosis of chronic appendicitis should be made guardedly, and usually, unless there is definite historical evidence, only after the exclusion of other causative factors for the symptoms.

In the records of Lenox Hill Hospital from 1924 to date there are listed thirteen cases of gastrojejunal ulcer. Some of these patients had been operated upon previously at Lenox Hill and some at other institutions. As there were 227 cases of gastric and duodenal ulcers operated upon, this is about 5.7 per cent.

MULTIPLE VESICAL CALCULI

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WHILE vesical calculi are no novelty in urologic practice, the finding of 1,368 calculi in one bladder is worthy of note.

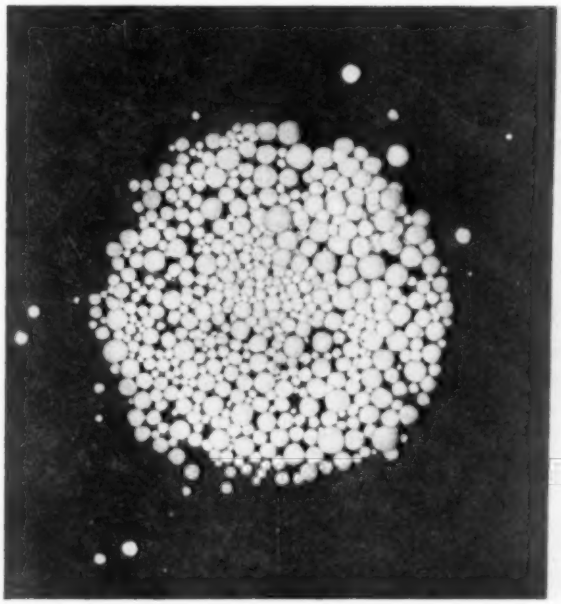

FIG. 1. Six hundred and four calculi removed at first cystoscopy.

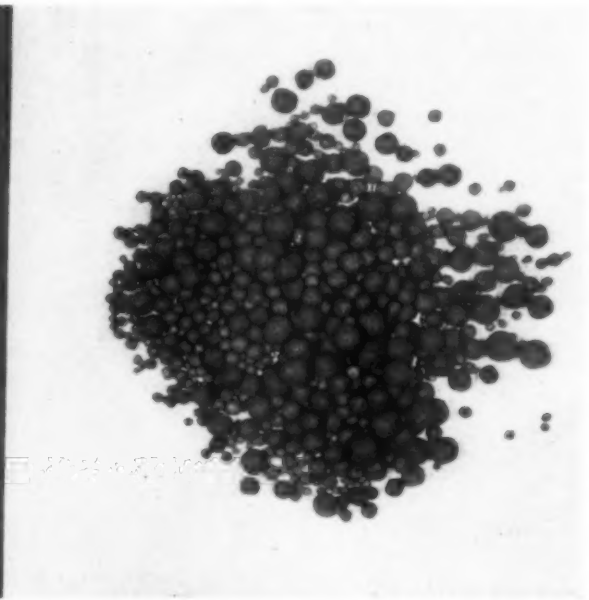

FIG. 2. Seven hundred sixty-four calculi removed at second cystoscopy. Note change of color due to instillation of argyrol.

CASE REPORT

J. C., a white Italian male of 62 years, was admitted to the Long Island College Hospital, September 29, 1936, complaining of frequency, nocturia, dysuria, and difficulty in starting to urinate, of two years' duration. He had had dyspnea and palpitation of the heart on very slight exertion for the past four years. Otherwise, his past history was negative.

Examination revealed an extremely obese, soft, wheezy individual. The heart was markedly enlarged; the sounds were of good quality, and the pulmonic second sound was increased over the aortic sound. There were no râles. There was no peripheral edema. Peripheral vessels were sclerosed. Rectal examination revealed the prostate small, but very hard, and immovable. A diagnosis of carcinoma of the prostate was made. The urine was acid and cloudy, but became clear on heating. No albumin, sugar, pus, blood or casts were present. The residual urine was 4 ounces. Blood chemistry was normal. The uric acid content was 2.4 mg. Blood Wassermann and Kahn tests were negative.

Cystoscopy was attempted under local anesthesia on the day of admission. The cystoscope was gripped so firmly at the bladder neck that very little motion was possible. Upon removing the obturator, urine containing many small, smooth, round calculi was evacuated from the bladder. By continuous washing, 604 of these calculi were removed. Observation of the bladder showed it to contain many more calculi of a size larger than those evacuated. Due to the discomfort of the patient, the procedure was discontinued. Argyrol was

instilled in the bladder before withdrawal of the cystoscope.

A plain *x*-ray film showed no evidence of calculi in the kidneys, ureters, bladder or prostate. Cystogram revealed a slight irregularity of outline of the bladder on the inferior aspect, which was unusual. The bladder showed so little elevation that it was questionable whether the findings were of significance. The presence of tumor infiltration was certainly possible.

On September 30, 1936, cystoscopy under spinal anesthesia was performed. Seven hundred and sixty four stones varying from about the size of a beebe shot to that of a marble were first evacuated, using a Bigelow aspirator. Due to instillation of argyrol into the bladder at the previous cystoscopy, the color of the calculi had changed from brown to black. Visualization revealed moderate trabeculation of the vesical musculatures. There were a few calculi, lodged in the interstices of the muscles, which were dislodged. The mucosa was healthy, the trigone was elevated, and there was a slight intravesical projection of the prostate. A McCarthy resectoscope was introduced and four pieces of tissue removed for biopsy. The pathologist's report on the excised tissue was carcinoma. An in-dwelling catheter was placed in the urethra and retained until October 3, 1936, when vesical neck resection was attempted under spinal anesthesia. At the beginning of the operation the patient stopped breathing and the operation had to be discontinued. Efforts at resuscitation were eventually successful, and a retention catheter was once more applied.

The patient recovered so rapidly that he was discharged on October 7, 1936, in perfect comfort with no residual urine. At the present writing no further resection has been done as he is still without urinary symptoms, and carries no residual urine.

SUMMARY

A case of multiple vesical calculi is presented. There was no history of passing stones, although 1,368 were finally recovered from the bladder. The bladder was not grossly infected. The calculi were uric acid in composition and were not radio-opaque. Removal of the calculi, together with a very small vesical neck resection, provided complete relief of symptoms.

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REPEATED ECTOPIC PREGNANCY SIMULATING INTESTINAL OBSTRUCTION

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INTRODUCTION

THE following case is presented because of its unusual character and difficulty in diagnosis, with the aim of clarifying certain points in the diagnosis of ectopic pregnancy and helping others to avoid the difficulties encountered by the author. The case is one of repeated ruptured tubal pregnancy with secondary abdominal implantation, which simulated at times a picture of acute cholecystitis and cholelithiasis, and at other times a picture of low ileal intestinal obstruction.

CASE HISTORY

V. S., a 43 year old Greek female, was admitted to the Cumberland Hospital on November 30, 1934 at 8:30 P.M., with a history of lower abdominal pains, nausea and vomiting for the previous month. The pains, located in the hypogastrium and both iliac quadrants, radiating upward and backward to both flanks and occasionally to the chest and both shoulders, came in attacks associated with nausea and, on several occasions with vomiting. Since 5:30 P.M. on the night of admission, the pains were quite severe and the patient was brought to the hospital by ambulance.

The patient also complained of weakness, dyspnea on exertion, poor appetite and a loss of eleven pounds during the month. She had pain at the onset of urination; there was frequency, but no burning or hematuria. She gave a history of constipation for a long time for which she had had recourse to pills or enemas. For one month, however, she had had pains on defecation. Her last bowel movement was in the morning of the day of admission.

The patient had her last regular menstrual period September 10, 1934, and flowed for three days. The next period was November 1, 1934. There was no period in October. This November period lasted only one hour and occurred approximately three days after the onset of the lower abdominal pains. The last full term pregnancy had occurred four years before, and there had been no miscarriages.

Past History. The past history was entirely negative except for a right salpingectomy on June 13, 1925. At that time the patient had been admitted to Mercy Hospital in Pittsburgh for the relief of "pelvic pain." At operation "an old ectopic of the right side was found, forming an hematocele the size of a hen's egg, densely adherent in the cul-de-sac; the appendix was also adherent to the mass; the left adnexa was found to be normal; a fibroid, the size of a hen's egg, was present in the anterior wall of the uterus; the gall-bladder was negative."

A salpingo-oophorectomy, ventral suspension of the uterus and a myomectomy were done at this time. The patient's post-operative course was normal. The pathologic report of the specimens removed revealed "tubal gestation; fibromyoma of the uterus and chronic interstitial appendicitis." The condition of the patient and wound when discharged were reported as "good."

Physical Examination. On admission to Cumberland Hospital, examination revealed an acutely ill elderly Greek female, moderately pale, lying comfortably in bed, and not in acute pain. The temperature was 99°F. the pulse 80 per minute and of good quality. The tongue was pale and dry. The conjunctivae were pale. The chest revealed occasional subcrepitant râles at the left base. The heart sounds were poor, no murmurs were made out, and the rhythm was regular. The abdomen was slightly distended, diffusely tender throughout, most markedly so in the lower abdomen, and there was rigidity of the right rectus. On pulling the lower midline abdominal scar, marked tenderness was elicited. The epigastrium was tender to deep pressure and there was marked tenderness to percussion in both costovertebral angles.

Vaginal examination revealed the cervix to be slightly softened and tender to motion, the

uterus anterior, slightly enlarged and tender to motion. There was exquisite tenderness in both adnexae and in the posterior cul-de-sac, but no masses were palpated and no bleeding was evidenced. Urine examination on admission was negative. The white blood count was 11,200, with 80 per cent polys and 20 per cent lymphocytes. Sedimentation time was one hour and fifteen minutes.

At this time, in view of the anomalous menstrual period preceding the onset of the pain, the pallor and the vaginal findings, it was believed the patient might have a ruptured tubal pregnancy. However, several hours after admission to the hospital the clinical picture had entirely changed—the patient became very restless, began to complain bitterly of pain in the right upper quadrant and across the middle of her back. At this time, she still had diffuse abdominal tenderness, but there was marked tenderness in the right upper quadrant and pain was referred to the right shoulder on pressure over the gall-bladder region. Deep inspiration caused the patient to catch her breath because of aggravation of her generalized abdominal pain with radiation to both shoulders and the back.

In view of the change in the clinical picture at this time, with the localization of the most marked point of tenderness over the gall-bladder region, it was felt that the patient was suffering from a recurrent attack of cholecystitis with possible pancreatitis. It was decided to watch the patient further, and she was therefore given morphine and fluids parenterally.

Pre-Operative Course. During her entire course of careful observation over a period of several weeks, the patient ran an irregular low grade temperature to 101°F., with corresponding pulse. She continued to complain bitterly of pain in the right upper quadrant and epigastrium and had repeated attacks of vomiting. The tenderness in the epigastrium, under the right costal margin, and in the lower abdomen continued, and the abdomen became diffusely distended. The pain in the right upper quadrant finally subsided, but those in the lower abdomen and the epigastrium remained. The patient had difficulty in moving her bowels and had only partial results from repeated enemas. A flat plate of the abdomen at this time revealed "several gas distended loops of ileum in all the four quadrants of the abdominal cavity." It was felt the patient had chronic intestinal obstruction dependent on old pelvic adhesions. Examination by means of barium enema failed to reveal any obstruction in the filling of the colon and attempts at a gastric series were unsuccessful because of the patient's weakness and persistent vomiting.

The patient gradually developed a definite pallor and examination of the blood revealed a red count of 2.1 million red blood cells and a hemoglobin of 35 per cent. In view of this, the patient was given a transfusion of 500 c.c. of whole blood, but there was apparently no improvement in her color or general condition. The abdomen remained distended and tympanitic throughout in spite of repeated gastric lavage and soap suds enemas. The patient developed a pasty yellow color and slight jaundice of her sclera; a second transfusion of 380 c.c. of whole blood was again given.

Operation. In view of the persistence of the anemia in spite of several transfusions and the development of a slight jaundice, it was felt finally, after prolonged observation, that the patient had some form of concealed hemorrhage, probably a ruptured ectopic. On December 20, 1934, she was operated upon and an intra-abdominal pregnancy of three to four months' duration was found, with the peritoneal cavity filled with a large amount of blood, both old and fresh. The placenta, the size of a grapefruit, filled the entire pelvis and was adherent to the intestines and omentum. In the attempt to free this mass in order to get at the site of the hemorrhage, a 3 to 4 month old fetus was found lying in the abdominal cavity. The mass, together with several large blood clots, was removed and the bleeding was controlled with mass ligatures and suture ligatures. The stumps of the left tube and ovary were removed, the free ends sutured, and an iodoform pack was placed against the placental site to control the bleeding. The abdomen was closed in the usual manner and the patient was given another transfusion of 500 c.c. of whole blood.

Post-Operative Course. Immediately after operation the patient ran a persistent temperature between 103 and 104°F. with a corresponding pulse of fair quality. The wound drained a profuse amount of serosanguinous material. The abdomen again became markedly distended, but at times this could be relieved by continuous gastric suction combined with enemas. Diffuse wheezes throughout the chest were heard and there was a mucoid expectoration. Her general condition did not improve in

spite of all supportive treatment. She had persistent vomiting and developed an extremely marked and tense abdominal distention. On the twelfth day after operation, she developed numerous moist râles in her chest with a frothy bloody expectoration, indicative of pulmonary edema. This caused death.

Pathologic Report. Pathologic examination of the specimen removed at operation was described by Dr. S. H. Polayes as follows:

"Specimen is a fetus measuring about 4.5 cm. in length with well defined digits and almost completely developed genitalia. This is accompanied by masses of placental tissue weighing 335 Gm. Together with the placental tissue is found an irregular mass containing fat and necrotic hemorrhagic structure. Microscopic examination reveals that the tissue consists of a large amount of blood clot and fibrin network which surrounds areas of degenerated chorionic villi. In some portions there are large syncytial masses present. The accompanying omental tissue is the seat of acute inflammatory infiltration and marked hemorrhage. *Diagnosis:* Intra-abdominal pregnancy; degenerated placental tissue; acute inflammation of the omentum."

DISCUSSION

While cases of repeated extra-uterine gestation in the same patient are not an uncommon occurrence, its occurrence in this case serves to emphasize again, as some authors have done, the importance of pathology in the opposite adnexa or the uterus as a probable cause for repeated ectopic pregnancies. It is interesting to note that the very first recorded case of extra-uterine gestation, that of Albucasis in the middle of the eleventh century, was one of repeated extra-uterine pregnancy, according to William Campbell.[1] "Albucasis, as may be learned from his writings, simply states the fact of an abscess having formed at the umbilicus from which fetal bones had been extracted, in a patient in whose uterus the fetus died in two successive pregnancies. . . . And as it is said that in both pregnancies the fetus had died in utero, it might be supposed that in consequence of rupture of the organ, they had, thereafter, on one or both occasions escaped into the abdominal cavity; but as the narration of the case does not bear that the patient met with any accident, and that there are no symptoms mentioned characteristic of such an injury, or of retroversion of the uterus even, the inference is perfectly legitimate that in both gestations the ovum had not entered the uterus, but had been retained in one of its appendages, or developed in connection with them in the peritoneal cavity."

It is also extremely interesting to note that the earliest case of abdominal section for ectopic pregnancy which has been found on record is that of Primerose,[2] who operated in October 1594, on a woman, aged 30, who after seven normal gestations, had two extra-uterine pregnancies, the first of which evacuated itself spontaneously through the abdominal wall. Parry[3] in discussing "gastrotomy" as a measure in the treatment of extra-uterine pregnancy, states: "The earliest case which we have been able to find upon record is that of Primerose, who operated in October 1594. The history of this patient has become classic. She was twice pregnant with extra-uterine children—first in 1591 and again some time before 1594. The cyst of the first child opened spontaneously through the abdominal wall. The fistula was enlarged, and this child extracted by Jacob Noierus, a surgeon. This operation proving successful, Primerose removed the second infant by gastrotomy two months later. It is easy to imagine how he was led to perform the second and more hazardous operation."

The incidence of repeated ectopic pregnancies has been variously reported by different authors as ranging from 1 to 16 per cent. This may be due to differences in opportunities for following up these patients, as illustrated in the case presented, where the patient was operated upon a second time in a different hospital in another city.

There seems to be a very definite number of patients with ectopic pregnancies who

INCIDENCE OF REPEATED ECTOPIC PREGNANCIES

Author	Total Number of Cases	Number of Cases of Repeated Ectopics	Per cent of Repeated Ectopics
R. R. Smith[4]	144	21	14.5
Am. Gynec. Soc[4]	1608	58	3.6
Literature to 1914[4]	1390	55	4
Giles[5]	39	5	12.8
Brady[6]	50	2	4
Behney[7]	167	2	1.2
Sheffey[8]	82	5	6.09
Urdan[9]	474	27	5.7

will be candidates for a repetition of this catastrophe on the opposite side. Schuman[10] concludes from examining 280 cases, that "about one woman in eight who had had one extra-uterine pregnancy may expect another." Not only is she subject to another ectopic gestation in the opposite tube, but Hassenblatt[11] collected twenty-one cases of recurrence in the same tube, many occurring in the stump after salpingectomy. The reason for the incidence of recurrent extra-uterine pregnancy is given by Schumann.[10] "The causes underlying tubal pregnancy are frequently identical in both tubes and should one tube be removed for the relief of this condition, it is reasonable to suppose that the other tube may be similarly affected at some subsequent period." I. C. Rubin[12] examined the status of the residual tube following ectopic pregnancy by means of tubal insufflation with gas, and found that of ninety patients examined, "only 12.35 per cent of the ninety tubes were normally patent, 43.21 per cent were completely obstructed, and 44.44 per cent were partially obstructed." Because of this, many authors have recommended removal of both adnexae at the time of operation for the ectopic gestation.

The incidence of pathology of the opposite tube noted at the time of operation, is about the same as repeated ectopic pregnancy occurring in these cases. Urdan[9] noted that, of 474 cases, 10.3 per cent presented evidence of tube pathology on the other side. Lavell[13] observed that chronic inflammation of the opposite tube was noted in eighty-one instances of 419 cases examined. Sheffey[8] found as high as 39 per cent of eighty-two cases of ectopic pregnancy had abnormalities in the opposite adnexa at the time of operation. It is for these reasons that Smith[4] recommends removal of the opposite tube when children are not desired. I. C. Rubin[12] comes to the conclusion that at the time of operation, "the uninvolved tube should be carefully scrutinized, and if it is hopelessly diseased, and the patient has borne a child, it should be removed. If only partially impaired, it should be left in situ because intra-uterine pregnancy occurs more often under such conditions than tubal pregnancy." Shumann and Rubin both found that an intra-uterine pregnancy occurs four times more frequently following an ectopic than does a subsequent ectopic. "The age of the patient, her parity, and her desire to bear more children, should influence and determine the procedure."

The reason for the upper abdominal manifestations and pain in the back and shoulder in our case is quite evident. The patient had a massive intraperitoneal hemorrhage, and since she was in dorsal decubitus position, the blood rapidly spread to the upper abdomen, irritating the under surface of the diaphragm and posterior parietal peritoneum. The pain was therefore referred to these irritated points. Pain in both shoulders is due to the fact that the under surface of the diaphragm, irritated by the blood, is supplied by the same nerves (C_3, 4, 5), as those to the skin of the outer aspect of the shoulders. Pain in the shoulder due to blood in the abdomen, is frequently referred to as Laffont's sign, for Laffont[14] noted extra-pelvic referred pain which was located in the epigastrium, infracostal region, shoulder, retrosternal and interscapular regions, and in the base of the neck in sixteen cases in which the abdomen was filled with blood. The incidence of upper abdominal manifestations in recorded cases of ectopic

pregnancies is not insignificant. Of 410 cases of ectopic where radiation of pain was specified, Lavell[13] found eighteen who referred their pain to the upper abdomen. And of 474 cases, Urdan[9] found twelve had pain in the upper abdomen.

The occurrence of jaundice in our case was misleading, whereas it should have been confirmatory. The hyperbilirubinemia occurs as the result of the absorption of the intraperitoneal blood. Some authors have used this as a confirmatory laboratory finding in questionable cases of ectopic pregnancy with hemorrhage. Dumphy and Fallon[15] in discussing the diagnosis of extra-uterine pregnancy, pay special attention to this, and use this as a confirmatory sign. "It is well known that jaundice may occur from intraperitoneal hemorrhage. One of our errors in diagnosis (in forty-two cases of extra-uterine pregnancy) was made chiefly because of the presence and misinterpretation of jaundice. At operation, it was evident that the jaundice was due to absorption of old blood (bile pigment). Afterward, visible jaundice was observed in four cases of extra-uterine pregnancy, and in three cases of intra-abdominal hemorrhage from other causes. In eight of twelve of our recent cases of extra-uterine pregnancy, the serum bilirubin was found well above normal. We discovered that this was a very important sign and that in the decision of a doubtful case, it is a diagnostic sign when present."

No case was found of ruptured ectopic pregnancy, fully described in the literature, that simulated intestinal obstruction as well as did the one here reported. The patient continued to vomit, remained moderately to markedly distended and had only slight and infrequent bowel movements with enemas, during the whole period of her observation. The reason for this is quite evident, when one recalls the findings at operation. The placental mass, blood clots and fetus were intimately adherent to loops of intestine, parietal wall and omentum in the lower half of the abdomen and pelvis. Back in 1889, E. E. Montgomery, in discussing the treatment of ectopic gestations in Lawson Tait's Monograph,[16] described exactly such conditions. "In the peritoneal or abdominal form, the envelope of the fetus is partially composed by the gluing together of the intestinal loops and viscera of the abdomen in proximity to it. In such cases, the symptoms will depend largely upon the site of the placenta. If in its growth it becomes attached to the intestines, it generates such a congestion of the intestinal structures as to lead to violent catarrhal symptoms, such as vomiting, purging, and frequently recurring severe intestinal pains. The only relief is the arrest of the vitality of the ovum." To accomplish this, he recommended electricity or the faradic current.

Behney,[7] in discussing three deaths in 167 cases of ectopic, states that there was one admitted with intestinal obstruction, complicating an old ruptured extra-uterine pregnancy. Urdan,[9] analyzing the fourteen cases that died post-operatively among 474 cases of ectopic, found that "two cases died of intestinal obstruction." Many more cases of secondary abdominal pregnancy probably give rise to the picture of intestinal obstruction, especially before the fifth month, before fetal parts can be made out or the fetal heart heard, by reason of the wide attachment of the placenta and the organization and fibrosis produced by the blood clots, but no statistics are available. The clinical picture must be of sufficient frequency to be kept in mind, i.e., that secondary abdominal pregnancy due to ruptured tubal pregnancy may simulate intestinal obstruction by its persistent vomiting, distention, colicky pains and obstipation.

SUMMARY

A case of repeated ruptured tubal pregnancy with secondary abdominal implantation which simulated a case of low ileal obstruction is here presented. The incidence of repeated ectopic gestations is discussed, and the importance of examination

of the opposite tube is emphasized in determining the operative procedures to be carried out at the time of operation. The reasons for the clinical findings in this case are mentioned with the aim of emphasizing the importance of shoulder pain, jaundice, midline colicky pains, together with vomiting, distention and obstipation, in the diagnosis of the obscure case of the less dramatic type of ectopic pregnancy.

I take this opportunity of thanking Dr. John E. Jennings for the privilege of presenting this case, and Dr. Chester L. Davidson, on whose service the case was followed.

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PERFORATED APPENDICITIS SECONDARY TO A COMMON STRAIGHT PIN

REPORT OF A CASE

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History. F. B., a girl of 17, was admitted to the Reading Hospital January 20, 1937 at 10 P.M. Her chief complaint was sharp pain

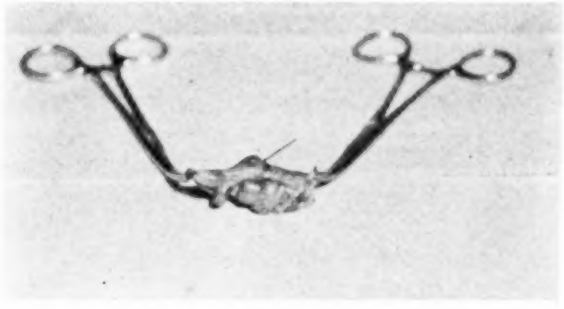

FIG. 1.

in the lower part of the abdomen on the right side. The patient had become aware of the pain for the first time at 2 A.M. of the same day. After about six hours the pain had become so severe that it caused her to double up, and this continued until her admission to the hospital. There was no associated nausea or vomiting. The bowels moved normally the day prior.

The previous medical history was entirely negative except for convulsions in infancy. She had never had any operations nor was there any history of accidents. Upon questioning, no history was obtained of having swallowed a pin nor of using pins in her work as a helper in a shirt factory.

Examination. The patient was a young, white female, well developed, and of excellent general appearance with, however, a manifest expression of severe distress.

The blood pressure was 126 systolic, 84 diastolic; the temperature, 101°F.; the pulse 105 and the respiration rate 22.

The examination of the head and neck was grossly negative, as was also the examination of the chest. The abdominal examination revealed a generalized resistance throughout, with marked rigidity in the lower abdomen, particularly on the right side. The hymen was intact. On digital rectal examination there was some tenderness on the right side.

The urine was normal. A complete blood count showed: hemoglobin 92 per cent; red blood cells 4,500,000; white blood cells 9,400; color index .9; polymorphonuclears 84 per cent; small mononuclears 14 per cent and transitionals 2 per cent.

A diagnosis of acute appendicitis was made and the patient promptly operated upon.

Operation. Under spinal anesthesia a short right rectus incision was made, and the lower portion of the cecum brought up. The appendix easily came into view, and at once a narrow sharp black object on the anterior aspect was visible. (Fig. 1.) It had perforated the appendix and was easily visible for a quarter of an inch. The appendix was large, red and indurated, particularly the middle one-third. A large portion of the serosa was covered with a yellowish plastic exudate. The appendix was removed by clamp and cautery and the base doubly ligated. The abdomen was closed in layers.

Pathologic Examination. The specimen consisted of an appendix weighing 8 Gm. and measuring 5 cm. in length with a uniform diameter of 1 cm. The serosa was dull, pinkish red and finely granular, with a thin yellowish plastic exudate. From a middle perforation, the point of a straight pin measuring 2.8 cm. protruded. The wall was thickened with fibrosis and edema, and the mucosa was reddish pink with punctate hemorrhage. The lumen was patent with a serosanguinous exudate and contained the pin mentioned.

Postoperative Course. The postoperative convalescence was entirely uneventful. The patient was allowed out of bed on the seventh day and was discharged from the hospital on the ninth day. She continued to do well and went back to work at the end of three weeks.

TOTAL REMOVAL OF THE PATELLA

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THE number of procedures suggested for treating comminuted and compound comminuted fractures of the patella shows that the whole subject is still open for discussion. If our aim is to restore the patient to economic usefulness in the shortest possible time, improvement on the usual methods must be tried. Total removal of the patella is not widely practiced by the profession; therefore reports of isolated cases seem justified.

My attention was first called to this procedure during the war.[1] An early case was reported by C. C. Rogers.[2] Rynard[1] states that Althmann removed almost all the patella in 1890 with perfect function, and that Turner in 1886 removed the entire patella and sutured the quadriceps tendon to the patellar tendon, but movements of the knee were very limited. A recent article by Blodgett and Fairchild[3] reports a large series of cases, and contains many references to the literature and helpful suggestions. Naturally the lateral tears in the capsule must be carefully sutured. If this is done it seems entirely possible to have a good knee with the patella completely gone.

CASE REPORT

J. A., age 24, on September 26, 1936, while riding a motorcycle, crashed into the side of an automobile. His only serious injury was to the left knee. There was a 7 inch lacerated wound in the midline, opening the knee joint. The patella was badly comminuted, the anterior crucial ligament torn loose, the semilunar cartilages broken into small bits, and a part of the internal condyle broken off and hanging from the wound. Every part was contaminated with street dirt ground into the tissues.

Under general anesthesia a thorough cleansing was done, using green soap, followed by copious irrigations with saline solution. A thorough débridement was done. As the internal condyle was hanging by a mere thread of periosteum this was removed; all of the fragments of the semilunar cartilage were picked out of the joint. The torn crucial ligament was ignored. The different pieces of the patella were removed and a closure of the knee joint done by side-to-side suture with chromic gut. There was considerable undermining of the subcutaneous tissues of the lower thigh. These areas were opened widely and soft rubber drains inserted. The leg was put on a posterior plaster splint in extension. Tetanus and gas antitoxins were given.

The wound never showed any sign of infection, though the temperature ranged from 100 to 103 for eight days. (I believe this was reaction to the antitoxins.) After the eighth day the temperature was normal. Active motion was started after three weeks in bed. The patient was walking with crutches in six weeks, and within a few days the crutches were discarded. At the end of three months he walked without a limp, and could walk up and down stairs normally. Extension was normal but flexion was limited 25 per cent. At six months, flexion had improved another 10 per cent, and he had been back at work for a month. The knee does not buckle nor does it hurt. There were enough complicating factors to account for the small loss of flexion.

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NEW INSTRUMENTS

AN APPLICATOR FOR THE USE OF THE ELLIOTT TREATMENT IN THE LARGE INTESTINE THROUGH THE COLOSTOMY STOMA

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WE wish to describe an apparatus which we have devised for the direct application of heat to the wall of the large intestine through a colonic stoma. The principle is exactly the same as that used in the Elliott treatment for pelvic inflammatory disease. The applicator is made of rubber and allows a continuous circulation of water from the Elliott machine.

Figure 1 illustrates the construction and dimensions of the type of applicator which we have used in certain cases, together with a picture of the apparatus in situ. The rubber pouch is saddle-shaped to conform to the usual disposition of the bowel at the site of the colostomy. With a curved forceps one limb of the applicator is passed into the proximal limb of the loop while it is empty and the other limb is similarly placed in the distal limb of the loop. The point of junction of the two limbs rests directly on the spur between the two limbs of the loop of bowel, an important position for centering the heat. Adhesive tape may be used about the neck of the applicator to keep it in place. Usually, however, inflation of the applicator distends its limbs sufficiently to prevent its extrusion through the colonic stoma. The size of the applicator may be varied to the conditions needed; those dimensions given in Figure 1 are adequate for general use. An important point in construction is the size of the solid, non-distensible neck which is embraced by the colonic stoma when the apparatus is in position. (Fig. 1.) The neck of the applicator must not be too large, since the abdominal stoma frequently will be found to be small.

We have given the treatment to patients for periods varying from thirty to sixty minutes, using water at 120°F. under a pressure of from 1 to 2½ pounds. The treatments are well tolerated. Abdominal cramps, distention or other annoying symptoms have not been encountered. The patients experience the same general sensations as those which are encountered during the vaginal Elliott treatment.

The application of heat directly to the intestinal wall is especially useful in hastening subsidence of inflammation and edema which involve the intestine at the site of operation. For example, after the Mikulicz type of colonic resection or extraperitoneal resection with the three-bladed clamp, the two approximated loops of bowel frequently are the site of considerable inflammatory edema. In time the edematous inflammation subsides so that the partition between the two approximated loops can be broken down by the application of clamps and the continuity of the intestine restored. Clamps cannot be effectively applied to the edematous, thickened spur so frequently encountered and deliberate delay often is indicated between the successive steps which lead ultimately to closure of the colonic stoma and restoration of normal fecal current.

In this type of surgical procedure involving separate steps, the application of heat by the Elliott apparatus is helpful in

restoring the intestinal wall to its normal condition and thus hastening completion of the surgical treatment. After a few applications of heat through the stoma, the spur is found to be less thick than before and the adjoining segments of bowel are more pliable. If the spur is only partial, yet there has been no carriage of feces over into the distal loop, successive Elliott treatments will result in "melting" of the spur and the patient will have movements of feces through the normal channel in a surprisingly short time. In cases in which all feces have been passing through the colonic

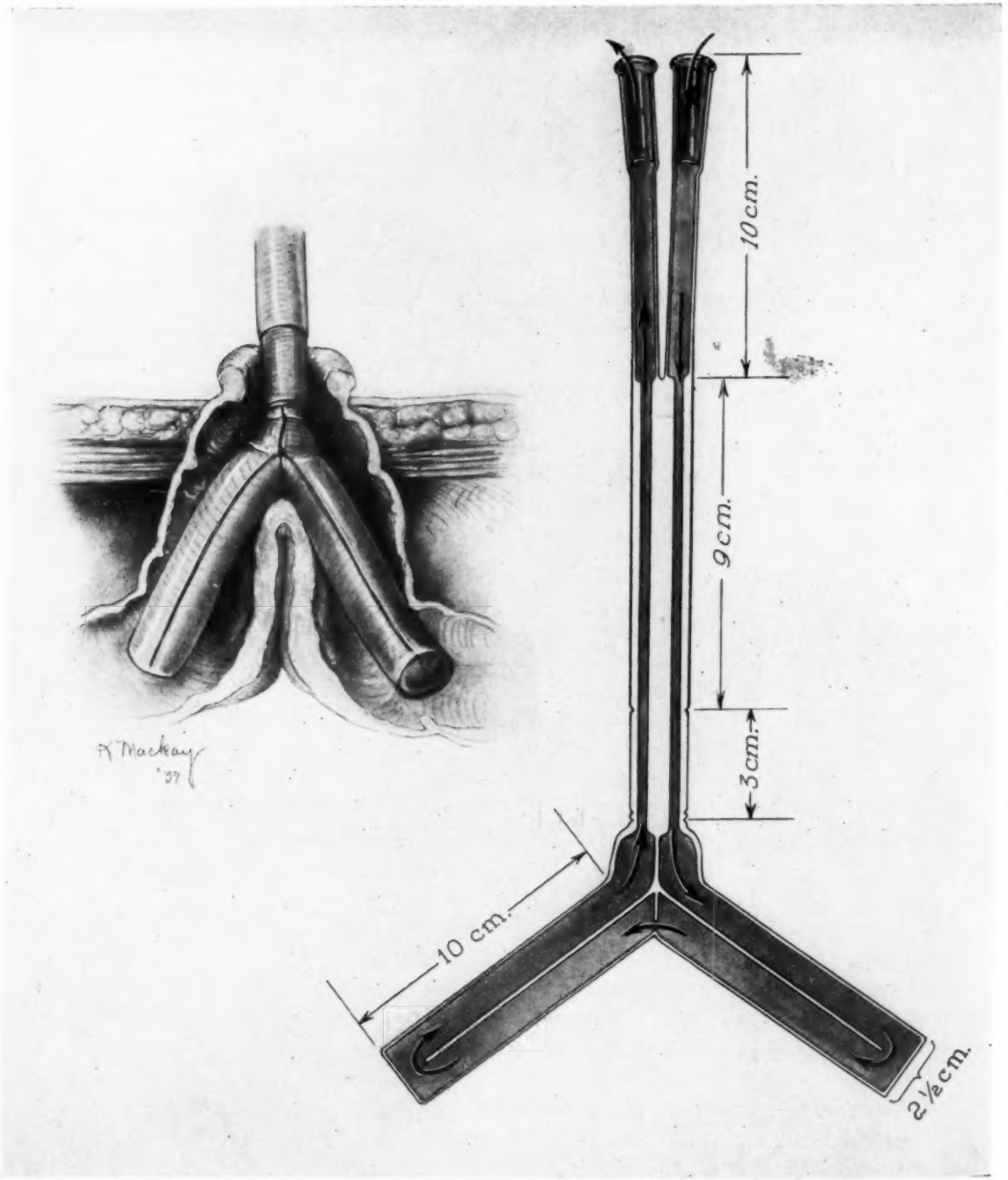

FIG. 1. Applicator for direct application of heat to large intestine: right, construction and dimensions of applicator; left, applicator in situ.

stoma, the patients have had rectal movements of more than half of the total feces after a short series of such treatments and there also has been marked shrinking of the colonic spur.

The applicator, with suitable modifications, may also find usefulness in the treatment of diverticulitis of the colon in those cases in which colostomy has to be performed to divert the fecal current. It can be used in conjunction with a rectal applicator, as described by Pemberton and Waugh.

The apparatus has many advantages over injections of hot water. Since, when the applicator is used, water does not come in direct contact with intestinal epithelium, irritation is avoided, an important factor is lessening the effectiveness of injections of water. The temperature of the water and its pressure in the applicator can be accurately controlled.

REFERENCE

1. Pemberton, J. deJ., and Waugh, J. M. The Elliott treatment as an adjunct in the surgical management of diverticulitis of the sigmoid flexure. *Surg., Gynec., and Obst.*, 65: 249–251 (Aug.) 1937.

Catarrhal or mucous proctitis is often associated with a like condition in the colon, and is characterized by a feeling of tenesmus, with a glairy white discharge which usually dries around the anus and is a fruitful source of pruritus.

From—"The Science and Practice of Surgery" by W. H. C. Romanis and Philip H. Mitchiner, 6th Ed. (Churchill).

A SIMPLE SUCTION SIPHONAGE APPARATUS

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THE usefulness of simple water suction siphonage in the treatment of a variety of conditions is now generally recognized. Introduced by Wangensteen[1] it has found its most common use in gastro-intestinal decompression, usually with the Levin tube. For several years I have been using a set-up which is simple, inexpensive, and requires a minimum of attention.

FIG. 1.

As shown in Figure 1, it consists of the usual bottle on the floor connected to the suction bottle, which has a stout glass nipple projecting from its base. The tubing leading from the floor bottle is connected to this nipple. Hence, the suction bottle stands upright on any convenient stand or table, and as it also has a fairly large opening at the top, it is a very simple matter to pour water into it from any pitcher. The mouth is filled with a one-hole cork having a connection leading to the collecting bottle which has a two-hole cork. Through the other hole, a connection is made with a Levin tube. As shown, there is a "Y" interposed to facilitate irrigation when desired.

I have had constructed a small wooden table 43 by 21 by 17 inches with a low raised edge around the top. It also has a low shelf on which the floor bottle may be set. The table is mounted on rubber wheels and the whole outfit may be kept connected, wheeled to the bedside and put in operation in a short time and with a minimum of effort.

While the apparatus is in use, the only attention required is to pour water from the floor bottle to the suction bottle and to empty and clean the collecting bottle. The use of a collecting bottle, while not essential, is advantageous for the following reasons:

1. Aspirated material may be measured and, if desired, readministered.

2. It is difficult to keep the suction bottle clean around the glass nipple; hence it is better to have only water in it.

The special bottle with glass nipple may be obtained from the Physicians and Hospital Supply Co., 412 South Sixth Street, Minneapolis, Minnesota.

REFERENCE

1. WANGENSTEEN, O. H., and PAINE, JOHN R. Treatment of acute intestinal obstruction by suction with duodenal tube. *J. A. M. A.*, 101: 1532 (Nov. 11) 1933.

[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

THE UNEQUAL MARRIAGE*

WITH BIOGRAPHY

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THE ARGUMENT

THE unequal Marriage exposes to View the Folly of People in common, who in their Espousals chiefly regard the Greatness of the Fortune, and disregard the Diseases of the Husband, tho' they are worse than the Leprosy itself. The Description of a deform'd Man. That the Cruelty of Parents in matching their Daughters, is worse than that of *Mezentius*, of which *Virgil* writes in his Tenth Book of *Aeneids*. He describes the Vices of a bad Husband; that this is not marrying a Man, but a dead Carcass. In getting Dogs, Calves, and Horses, they take Care to have one strong Beast copulate with another, good ones with those that are like themselves; nor won't suffer a diseas'd one to leap a sound one. That the Commonwealth sustains a great Detriment by these foolish and unhappy Marriages.

PETRONIUS AND GABRIEL

Pet. Whence is our *Gabriel* come, with this sour look? what, is he come out of *Trophonius's* Cave?

Ga. No, I have been at a Wedding.

Pet. I never saw a Look in my life that had less of the Air of a Wedding in it; for those that have been at Weddings, use to look cheerfully and airily for a whole Week, and old Men themselves to look younger by ten Years. What Wedding is it that you have been at? I believe at the Wedding of Death and the Cobler.

Ga. Not so, but of a young Gentleman with a Lady of Sixteen, who has all of the Accomplishments that you can wish for, whether Beauty, good Humour, Family, or Fortune; in short, a Wife fit for *Jupiter* himself.

Pet. Phoo! what, so young a Girl to such an old Fellow as he?

Ga. Kings don't grow old.

Pet. But what makes you so melancholy then? It may be you envy the Happiness of the Bridegroom, who has rival'd you.

Ga. Pshaw, there's nothing of that in the Matter.

Pet. Well then, has any Thing happen'd like what is related of the *Lapithae's* Feast?

* From the translation of Erasmus by N. Bailey, publ. by Reeves & Turner, London, 1878.

Ga. No, not so neither.
Pet. What then, had you not Wine enough?
Ga. Yes, and too much too.
Pet. Had you no Pipers?
Ga. Yes, and Fiddlers too, and Harpers, and Trumpeters, and Bagpipers.
Pet. What was the Matter then? Was not *Hymen* at the Wedding?
Ga. They called loudly for him with all this Musick, but to no purpose.
Pet. Were not the *Graces* there neither?
Ga. Not a Soul of them, not Bridemaid *Juno*, nor beautiful *Venus*, nor *Jupiter Gamelius*.
Pet. By my troth, you tell me a story of a dull Wedding indeed, an ungodly one, or rather an unmarried Marriage.
Ga. You would have said so indeed, if you had seen it.
Pet. Had you no dancing at it?
Ga. No, but we had wretched limping.
Pet. What, had you no lucky Godship at all to exhilarate the Wedding?
Ga. No, not one there but a Goddess, that the *Greeks* call *Psora*.
Pet. Why, you give me an Account of a scabby Wedding indeed.
Ga. Nay, a cankered, and a pockey one.
Pet. But, prithee, Friend *Gabriel*, tell me, What makes the Remembrance of it fetch Tears from your Eyes?
Ga. Ah! dear *Petronius*, it is enough to fetch Tears from a Flint-Stone.
Pet. I believe so, if a Flint-Stone had been present, and seen it. But prithee, What extraordinary Mischief is this? Don't hide it from me, nor keep my Expectation any longer in Suspense.
Ga. Do you know *Lampridius Eubulus?*
Pet. Yes; there is not a better nor happier Man in the City.
Ga. Well, do you know his daughter *Iphigenia* too?
Pet. You have mentioned the very Flower of the Age.
Ga. She is so; but, do you know who she's married to?
Pet. I shall know when you have told me.
Ga. She is married to *Pompilius Blennus*.
Pet. What, to that Hector, that us'd to talk Folks to Death in cracking of his bullying Tricks?
Ga. To the very Man.
Pet. He has been for a long Time very noted in this Town, to two Things chiefly, *i.e.* Lying, and the Mange, which has no proper Name to it, tho' indeed it has a great many.
Ga. A very proud Distemper, that won't strike Sail to the Leprosy, the Elephantine Leprosy, Tetters, the Gout, or Ringworm, if there was to be an Engagement between them.
Pet. So the Sons of *Esculapius* tell us.
Ga. What Need is there, *Petronius*, for me to describe to you a Damsel that you are very well acquainted with? altho' her Dress was a great Addition to her native Beauty. My *Petronius*, you would have taken her for a Goddess, had you seen her. Everything in her and about her was graceful. In the mean Time out comes our Blessed Bridegroom with his Snub-Nose, dragging one Leg after him, but not so cleverly neither as the *Switzers* do; itchy hands, a stinking Breath, heavy Eyes, his Head bound up with a Forehead-Piece, and a Running at his Nose and Ears. Other People wear their Rings on their Fingers, but he wears his on his Thighs.
Pet. What was in the Mind of the Lady's Parents, to join such a Daughter to a living Mummy?
Ga. I can't tell, except it was with them, as it is with many more, that have lost their Senses.
Pet. It may be that he was very rich.
Ga. He is very rich indeed, but it is in the Debts he owes.
Pet. What greater Punishment could they have inflicted upon the Maid, if she had poison'd her Grandfathers and Grandmothers, both of the Father's and Mother's Side?
Ga. Nay, if she had scatter'd her Water upon the Grave of her Parents, it

would have been a Punishment bad enough to have oblig'd her but to have given a Kiss to such a Monster.

Pet. I am of your Mind.

Ga. I look upon it a greater Piece of Cruelty, than if they had stripp'd their Daughter naked, and expos'd her to Bears, Lions, or Crocodiles: For these wild Beasts would either have spar'd her for her exquisite Beauty, or put her out of her Pain by a quick Dispatch.

Pet. You say right: I think this is what would have become *Mezentius* himself, who, as *Virgil* tells us, *bound dead bodies to living ones, Hands to Hands, and Mouths to Mouths.* But I don't believe *Mezentius* himself would have been so inhuman as to have bound such a lovely Maid to such a Carcass as this: Nor is there any dead Body you would not chuse to be bound to, rather than to such a stinking one; for his Breath is rank Poison, what he speaks is Pestilence, and what he touches mortifies.

Ga. Now, *Petronius*, imagine with yourself what a Deal of Pleasure she must needs take in these Kisses, Embraces, and nocturnal Dalliances.

Pet. I have sometimes heard Parsons talk of unequal Matches; that may certainly with greatest Propriety be call'd an unequal Match; which is, as it were, setting a Jewel in Lead. But all this While I stand in Admiration at the Virgin's Courage; for such young Damsels are frightened out of their Wits at the Sight of a Fairy or a Hobgoblin; and can this Damsel dare to embrace such a Carcass as this in the Night-Time?

Ga. The Damsel has these three Things to plead in her Excuse: The Authority of her Parents, the Persuasion of her Friends, and the Unexperiencedness of her Age. But I am amaz'd at the Madness of her Parents. Who is there that has a Daughter never so homely, that would marry her to a Leper?

Pet. No Body, in my Opinion, that had a Grain of Sense. If I had a Daughter that had but one Eye, and but one Leg, and as deform'd as *Thersites* was, that *Homer* speaks of, and I could not give her a Penny for her Portion, I would not marry her to such a Son-in-Law as he.

Ga. This Pox is more infectious and destructive than the worst of Leprosies: It invades on a sudden, goes off, and rallies again, and frequently kills at last; while the Leprosy will sometimes let a Man live, even to extreme old Age.

Pet. Perhaps the Parents were ignorant of the Bridegroom's Distemper.

Ga. No, they knew it very well.

Pet. If they had such a Hatred to their Daughter, why did they not sew her up in a sack, and throw her into the *Thames?*

Ga. Why truly if they had, the Madness would not have been so great.

Pet. By what Accomplishments did the Bridegroom recommend himself to them? Was he excellent in any Art?

Ga. Yes, in a great many; he's a great Gamester, he'll drink down any body, a vile Whoremaster, the greatest Artist in the World at bantering and lying, a notable Cheat, pays no body, revels prodigally; and in short, whereas there are seven liberal Sciences taught in the Schools, he's Master of more than ten liberal ones.

Pet. Sure he must have something very extraordinary to recommend him to the Parents.

Ga. Nothing at all, but the glorious Title of a Knight.

Pet. A fine Sort of a Knight, that can scarce sit in a Saddle for the Pox! But it may be he had a great Estate.

Ga. He had once an indifferent one; but by his living so fast, has little or nothing left, but one little Turret, from whence he makes Incursions to rob Passengers; and that's so illy pro-

vided for Entertainment, that you would not accept of it for a Hog-Stye. And he's always bragging of his Castles, and Fiefs, and other great Things; and is for setting up his Coat of Arms everywhere.

Pet. What Coat of Arms does his Shield bear?

Ga. Three Golden Elephants in a Field Gules.

Pet. Indeed an Elephant is a good Bearing for one that is sick of the Elephantiasis. He must, without Doubt, be a Man of Blood.

Ga. Rather a Man of Wine; for he is a great Admirer of Red Wine, and by this Means he is a Man of Blood for you.

Pet. Well then, his Elephant's Trunk will be serviceable to him.

Ga. It will so.

Pet. Then this Coat of Arms is a Token that he is a great Knave, a Fool, and a Drunken Sot; and the Field of his Coat of Armour represents Wine, and not Blood; and the Golden Elephant denotes, that what Gold he had, has been spent in Wine.

Ga. Very right.

Pet. Well, what Jointure does this Bully settle upon his Bride?

Ga. What? Why a very great one.

Pet. How can a Bankrupt settle a large one?

Ga. Pray don't take me up so short; I say again, a very large one, a thundering Pox.

Pet. Hange me, if I would not sooner marry my Daughter to a Horse, than to such a knight as he.

Ga. I should abundantly rather chuse to marry my Daughter to a Monk; for this is not marrying to a Man, but to the Carcase of a Man. Now, tell me, had you been present where this Spectacle was to be seen, could you refrain from Tears?

Pet. How should I, when I can't hear it without? Were the Parents so abandoned to all natural Affection, as to throw away their only Child, a Virgin of such Beauty, Accomplishments, and sweet Conditions, by selling her for a Slave to such a Monster, for a lying Coat of Arms?

Ga. But this enormous Crime, than which you can't find one more inhuman, cruel or unlike a Parent, is made but a Jest on now-a-days by our People of Quality: altho' it is necessary that those that are born for the Administration of the Affairs of the Government, should be Persons of very sound and strong Constitutions: For the Constitution of the Body has a great Influence upon the Mind; and it is not to be doubted, but this Disease exhausts all the Brains a Man has: and by this Means it comes to pass, that our Ministers of State have neither sound Minds, nor sound Bodies.

Pet. It is only requisite that our Ministers of State should be Men of sound Judgment, and strong Constitutions but Men of Honour, and goodly Personages. Altho' the principal Qualifications of Princes are Wisdom and Integrity, yet it is of some considerable Moment what the Form of his Person is that governs others: for if he be cruel, the Deformity of his Body will expose him the more to Envy. If he be a Prince of Probity and Piety, his Virtue will be render'd more conspicuous by the Amiableness of his Person.

Ga. That's very true.

Pet. Don't People use to lament the Misfortune of those Women, whose Husbands, soon after their Marriage, fall into Leprosies or Apoplexies?

Ga. Yes, and that with very good Reason too.

Pet. What Madness is it then, voluntarily to deliver a Daughter over into the Hands of a Leper?

Ga. Nay, it is worse than Madness. If a Nobleman has a Mind to have a good Pack of Hounds, do you think he

would bring a mangy scoundrel Cur to a well-bred Bitch?

Pet. No, he would with the utmost Diligence look for a Dog, that upon all Accounts was of a good Breed, to line her, that he might not have a Litter of Mongrels.

Ga. And if a Lord has a Mind to have a good Breed of Horses, would he admit a diseased good-for-nothing Stallion to leap a most excellent Mare?

Pet. No, he would not suffer a diseased Stallion to enter his Stable Door, lest he should infect other Horses.

Ga. And yet, at the same Time, they don't matter what Sort of a Son-in-Law they gave their Daughter to, from whom those Children are to be produc'd, that are not only to inherit their Estates, but also to govern the State.

Pet. Nay, a Country Farmer won't suffer any Bull to leap a young Cow, nor every Horse his Mare, nor every Boar to brim his Sow; tho' a Bullock is design'd for the Plough, a Horse for the Cart, and a Swine for the Kitchen.

Ga. See now how perverse the Judgments of Mankind are. If a poor Fellow should presume to kiss a Nobleman's Daughter, they would think the Affront a Foundation enough to go to War upon.

Pet. And very hotly too.

Ga. And yet these Persons, voluntarily, knowingly, and deliberately, give up the dearest Thing they have in the World to such an abominable Monster, and are privately unnatural to their own Flesh and Blood, and publickly to their Country.

Pet. If the Bridegroom does but halt a little, altho' as to any Thing else he is perfectly sound, how is he despis'd for a Husband! And is the Pox the only Thing that is no Inconvenience to a married Life?

Ga. If any Man should marry his Daughter to a *Franciscan*, what an abominable Thing would it be accounted! what an Outcry would there be, that he had thrown his Daughter away! But yet, when he has pull'd off that Dress, he has every Way well-made sound Limbs; while the other must pass her Days with a rotten Carcase, that is but half alive. If any one is married to a Priest, he is banter'd on account of his Unction; but one that is married to one that has the Pox, has one whose Unctions are worse by Abundance.

Pet. Enemies that have taken a Maid captive, won't be guilty of such Barbarity as this; nor will Kidnappers themselves, to those they have kidnapped away; and yet Parents will be guilty of it against their only Daughter; and there's no Magistrate ordain'd to prevent the Mischief.

Ga. How should a Physician cure a Madman, if he has a Spice of the same Distemper himself?

Pet. But it is a Wonder to me, that Princes, whose Business it is to take Care of the Common-Wealth only in those Things which relate to the Body, of which nothing is of greater Moment than the Health of it, should find out no Remedy for this Evil. This egregious Pestilence has infected great Part of the Earth; and in the mean Time they lie snoring on, and never mind it, as if it were a Matter not worth their Notice.

Ga. Have a Care, Petronius, what you say as to Princes. But hark you, I'll tell you a Word in your Ear.

Pet. O wretched! I wish what you say were not true.

Ga. How many Disease do you think are caused by bad Wine, a thousand Ways sophisticated?

Pet. Why, if we may believe the Physicians, they are innumerable.

Ga. Well, and do the Ministers of State take any Care of the Matter?

Pet. They take Care enough as to the collecting the Excise, but no further.

Ga. She that knowingly marries a Husband that is not sound, perhaps may deserve to suffer the Punishment she has

brought upon herself; altho', if it were my Fortune to sit at the Helm, I would banish them both from civil Society: But if any one married one that was infected with this Disease, who told her he was a sound Man, and I were chosen Pope, I would make this Marriage void, altho' it had been confirmed by a thousand Contracts.

Pet. Upon what Pretence I wonder? For Marriage legally contracted can't be disannull'd by any human Power.

Ga. What? Do you think that legally contracted, which is contracted treacherously? A Contract is not valid, if a Slave palms himself upon a Maid for a free Man, and she marries him as such. She that marries such a Slave, marries an errant Slave; and her Slavery is so much the more unhappy, in that the Lady *Psora* never makes any Body free; that there's no comfortable Hope of ever being deliver'd from this Slavery.

Pet. Indeed you have found out a Colour of it.

Ga. And besides, there can be no such Thing as Marriage, but between those Persons who are living; but in this Case, a Woman is married to a dead Man.

Pet. You have found out another Pretence: But I suppose you would permit pocky Folks to marry pocky, that, according to the old Proverb, there might be *like to like*.

Ga. If it was lawful for me to act for the Good of the Public, I would suffer them to be married together, but I would burn them after they were married.

Pet. Then you would act the Part of a Tyrant, not of a Prince.

Ga. Do you account a Surgeon to be a Tyrant who cuts off some of the Fingers, or burns some Part to preserve the whole Body? I don't look upon that to be Cruelty, but rather Mercy. And I wish this had been done when this Distemper first appear'd in the World; then the publick Welfare of Mankind had been consulted by the Destruction of a few. And we find Examples of this in the *French* Histories.

Pet. But it would be a gentler Way to geld them, or part them asunder.

Ga. And what would you have done to the Women, pray?

Pet. I'd padlock them up.

Ga. That's one Way, indeed, to prevent us from having more of the Breed; but I will confess it is a gentler Way, if you will but own the other to be safer. Even those that are castrated, have an itching Desire upon them; nor is the Infection convey'd by one Way only, but by a Kiss, by Discourse, by a Touch, or by drinking with an infected Party. And we find also, that there is a certain malicious Disposition of doing Mischief peculiar to this Distemper, that whosoever has it, takes a Delight to propagate it to as many as he can, tho' it does him no good. Now if they be only separated, they may flee to other places, and may either by Night impose upon Persons, or on them that do not know them. But there can be no Danger from the Dead.

Pet. I confess it is the safest Way, but I can't tell whether it is agreeable to Christian Gentleness or no.

Ga. Prithee tell me then, from whom is there the most Danger, from common Thieves, or from such Cattle?

Pet. I confess Money is of much less Value than Health.

Ga. And yet we Christians hang them, nor is it accounted Cruelty, but Justice; and if you consider the publick Good, it is our Duty so to do.

Pet. But in this Case, the Person is punish'd that did the Injury.

Ga. What, then these, I warrant you, are Benefactors to the Publick? But let us suppose that some get this Distemper without any Fault of their own; tho' you will find that very few have it,

that don't get it by their own Wickedness: the Lawyers will tell you, it is sometimes lawful to put the Innocent to Death, if it be very much for the Good of the Publick; as the *Greeks*, after the taking of *Troy*, put *Astyanax*, the Son of *Hector*, to Death lest he should set a new War on Foot: Nor do they think it any Wickedness, to put a Tyrant's innocent Children to Death, after they have slain the Father. And do not we Christians go to War, tho' at the same Time the greatest Share of the Calamities falls on those Persons, that least deserve them? And it is the same Thing in our Reprisals, or Letters of Mark; he who did the Wrong is safe, and the Merchant is robb'd, who never so much as heard one Word of it, he is so far from being chargeable with the Fault. Now if we make Use of such Remedies as these in Things of no great Moment, what, think you, ought to be done in a Matter of greatest Consequence.

Pet. I am overcome by the Truth of your Arguments.

Ga. Then take this along with you too. As soon as ever the Plague begins to appear in *Italy*, the infected Houses are shut up, and the Nurses that look after the Sick, are forbidden to appear abroad. And tho' some call this Inhumanity, it is the greatest Humanity; for by this prudent Care, the Calamity is put a Stop to, by the Burials of a few Persons. But how great Humanity is it to take Care to preserve the Lives of so many thousands? Some think it a very inhospitable Thing for the *Italians*, when there is but the bare Report of a Pestilence, to drive travellers from their very Gates in an Evening, and force them to lie all night in the open Air. But for my Part, I account it an Act of Piety to take Care of the publick Good at the Inconvenience of a few. Some Persons look upon themselves very courageous and complaisant, in daring to venture to visit one that is sick of the Plague, having no Manner of Call at all to do it; but what greater Folly can there be, than by this Courage, when they come Home, to bring the Distemper to their Wives and Children, and all their Family? What can be more unkind, than by this Complaisance to a Friend, to bring those Persons that are the dearest to you in the World, into the Danger of their Lives? But then again, how less dangerous is the Plague itself than the Pox? The Plague frequently passes by those that are nearest, and seldom affects the old; and as to those that it does affect, it either dispatches them quickly, or restores them to their Health much sounder than they were before. But as for the Pox, what is that but a lingring Death; or, to speak more properly, Burial?

Pet. What you say is very true; and at least, the same Care ought to be taken to prevent so fatal an Evil, as they take to prevent the spreading of the Leprosy, or if this should be thought too much, no Body should let another shave him, but be his own Barber.

Ga. But what will you say, if both of them keep their Mouths shut?

Pet. They would take the Infection in at their Nostrils.

Ga. But there is a Remedy for that too.

Pet. What is it?

Ga. They may do as the Alchymists do, they may wear a Mask with Glasses for Eyes to see thro', and a breathing Place for their Mouths and Nostrils, thro' a Horn which reaches from their Jaw-Bones down to their Back.

Pet. That Contrivance might do pretty well, if there were no Danger from the Touch of the Finger, the Linen, the Combs and the Scissars.

Ga. But however, I think 'tis the best Way to let the Beard grow, tho' it be even down to the Knees.

Pet. Why, I am of that Mind too. And then let there be an Act of Parliament,

that the same Person shan't be a Barber and a Surgeon too.

Ga. But that's the Way to starve the Barbers.

Pet. Then let them spend less, and be something better paid for Shaving.

Ga. Let it be so with all my Heart.

Pet. And let there be a Law made too, that no Body shall drink out of the same Cup with another.

Ga. They will scarce be confin'd to that in *England.*

Pet. And that two shan't lie in the same Bed, unless they be Husband and Wife.

Ga. I like that very well.

Pet. And then as to Inns, let no Stranger sleep in the same Sheets that another has lain in before.

Ga. But what will you do then with the *Germans,* who scarce wash them twice a Year?

Pet. Let them employ Washer-Women. And besides, let them leave off the Custom of saluting with a Kiss, altho' it be of an old standing.

Ga. But then, as to the Churches?

Pet. Let every one hold his Hand before his Mouth.

Ga. But then as to common Conversation.

Pet. Let that Direction of *Homer* be observed, not to come too near the Person he talks to, and let he that hears him keep his Lips shut.

Ga. Twelve Tables would scarce contain all these Laws.

Pet. But in the mean Time, what Advice do you give for the poor unfortunate Girl?

Ga. What can I give her but this, that unless she likes being miserable, she be so as little as she can? to clap her Hands before her Mouth, whenever her Husband offers to kiss her; and to put on Armour when she goes to Bed with him.

Pet. Whither do you steer your Course when you go Home?

Ga. Directly to my Closet.

Pet. What are you going to do there?

Ga. They have desired me to write an *Epithalamium;* but instead of it, I will write an Epitaph.

Desiderius Erasmus was born at Rotterdam in Holland, on October 20th or 28th, in 1465, according to his Epitaph at Basil. His mother's name was Margaret, the daughter of one Peter, a physician of Sevenbergen. His father's name was Gerard.

Erasmus was born out of wedlock, and on that account Father Theophilus Raynaud has this pleasant passage concerning him: "If one be allowed to droll upon a man that droll'd upon the whole world, Erasmus, tho he was not the son of a King, yet he was the son of a crown'd head" (meaning a priest). But in this he appears to have been mistaken, in that the father was not in orders when he begat him.

Gerard was one of ten, himself the last. According to the superstition of the times, being the tenth child, the old people had a mind to consecrate him to God. Erasmus was after his father named Gerard, which in the German tongue signifies amiable. In those times it was the custom of learned men to affect their names in Latin or Greek. It was turned to Desiderius in Latin and Erasmus in Greek.

Erasmus was placed in school when four years of age. He was a Chorister at Utrecht until he was nine years old, and then was sent to Daventer to be instructed by the famous Alexander Hegius, a Westphalian. Erasmus was a remarkable student; his memory enabling him to recite Terence and Horace in entirety.

In his thirteenth year his mother died of the plague at that time sweeping the country. Soon after his father died of melancholy over the death of his wife. Neither parent was much over forty.

Erasmus had three guardians; and, although there was an ample fortune for his support and he was fit for the university, they designed him for a monastic life, removing him to Bois-le-Duc, where, he says, he lost three years living in a Franciscan convent. Suffering from a quartan ague he was obliged to return home.

By threats and flattery his guardians prevailed upon him to enter a monastery, but finding him not to be moved, they gave him up. Young Erasmus decided that he was old enough to take care of himself.

By accident Erasmus encountered Cornelius, a schoolmate at Daventer, and Cornelius induced him to enter the religious life, which offered the advantages of libraries, of learned men, and the freedom of distractions of the outer world. All of it fell short of his expectations, but, after a year of probation, he found himself with no alternative and became a member of their fraternity.

Erasmus was taken into the family of Henry à Bergis, Bishop of Cambray, and here his knowledge of Latin was useful. Later he was sent to the University of Paris; afterwards admitted to Montague College, when illness obliged him to return to the Bishop. His health restored, he made a journey to Holland, intending to settle there, but was persuaded to go a second time to Paris, where, having no patron to support him, he himself says, he rather made a shift to live than could be said to study.

He visited England, where he was received with great respect, and he honored it next to the place of his nativity. He passed some years at Cambridge; and he was particularly acquainted with Sir Thomas More, Colet, Dean of St. Paul, Grocinus, Linacer, Latimer, and many others of the most eminent of that time.

He again returned to France, but not meeting with the preferment he expected, he made a voyage to Italy. He took his Doctor of Divinity degree at the University of Turin; stayed about a year in Bologna; afterwards went to Venice, and there published his Book of Adages from the press of the famous Aldus. From there he went to Padua, and last to Rome, where his fame had arrived long before him. Here he gained the friendship and goodwill of all the influential men of the city and could not have failed to make his fortune. However he was prevailed upon by friends to return to England on Henry the Eighth coming to the crown. He was taken into favor by Warham, Archbishop of Canterbury, who gave him the living of Aldington in Kent. Again there were disappointments, probably because of the continual clashes between Warham and Wolsey, and Erasmus went to Flanders. Through Chancellor Sylvagius, he was made counsellor to Charles of Austria, later Charles v, Emperor of Germany.

Erasmus resided several years at Basel, but when the mass was abolished in that city by the Reformation, he retired to Friberg in Alsace, where he lived seven years. Having been afflicted with the gout for a long time, he left Friberg and returned to Basel. Here the gout soon left him, but he contracted dysentery and, after an illness of a month, died of that disease on the 22nd of July, 1536, in the house of Jerome Frobenius, son of John, the famous printer.

BOOK REVIEWS

PRACTICAL PROCTOLOGY. By Louis A. Buie, M.D., F.A.C.S. Philadelphia, 1937. W. B. Saunders Company. Price $6.50.

If either the medical student, practitioner, or surgeon desires a fairly small (512 pages, 151 illustrations), direct book on proctology, we would be neglecting our duty as a reviewer not to tell him that Dr. Buie has written such a volume. Dr. Buie for many years has been associated with the Mayo Clinic, and has had to do with the diagnosis and the medical and surgical management of diseases of the anus, rectum and colon. As Dr. Charles H. Mayo says in a short foreword, "Dr. Buie in this book has presented the old and the new in a most interesting and fascinating as well as practical manner." In a few words, this is an excellent review of the work we are discussing.

In every respect the work is truly practical. The subject is thoroughly covered, a bibliography is appended at the conclusion of each chapter, the illustrations are of a high order, and the index ample. Although etiology is covered with other basic scientific facts, what caught our attention was the amount of space devoted to what to do for the patient after a diagnosis has been made. How to make a diagnosis, however, is not neglected.

This is the sort of book one enjoys reading; one will refer to it many times in the course of his daily work. The publisher has given us a well written book, on good paper, with type easily read, and general make-up pleasing in every way. Decidedly a practical work, it will be welcomed by those who wish for a book on proctology as their guide in the practice of medicine.

INTRODUCTION TO OPHTHALMOLOGY. By Peter C. Kronfeld, M.D. Springfield, 1938. Charles C. Thomas. Price $3.50.

This book (331 pages) is a splendid work for the student as a prelude to the more formal, detailed and involved textbooks. Dr. Kronfeld, Professor of Ophthalmology at the Peiping Union Medical College, has endeavored (and successfully) to formulate the principles underlying that portion of ophthalmology which is a necessary part of basic medical education. The subject matter offered pertains principally to the pathogenesis of disease. The author has purposely omitted the details of diagnosis and the methods of examination. He discusses individual diseases to illustrate pathogenetic principles. Also, with intent, he has omitted a consideration of a large number of common diseases. Of these the reader will find a short description in the dictionary which is combined with the index of this book. References are listed at the end of each chapter.

The book is beautifully written. The publisher, as usual, has given us a book well nigh perfect typographically.

To those who want a book leading to the extended study of this subject this introduction is suggested.

THE TREATMENT OF CLINICAL AND LABORATORY DATA. AN INTRODUCTION TO STATISTICAL IDEAS AND METHODS FOR MEDICAL AND DENTAL WORKERS. By Donald Mainland, M.B., CH.B., D.SC. Edinburgh and London, 1938. Oliver and Boyd. Price 15 shillings.

We hope the majority of medical writers will own and carefully study this book (340 pages), written by the Professor of Anatomy at Dalhousie University. This statement is especially directed to those who offer statistical reports of the results of their laboratory and clinical researches. Donald Mainland has outlined here the treatment of clinical and laboratory data in such manner that our medical literature in the future should be the better for his teaching.

After the introduction (covering such topics as Neglect of Chance and Sampling Errors, Mathematical and "Commonsense" Methods, Method of Study), the chapter headings are: General Principles and the Estimation of Odds, The Comparison of Samples of Material Classified Qualitatively, Data Based on Measurements, Errors in Measurement, Correlation and Curve Fitting, Publication of Data and Results, and Supplementary Notes.

There are four pages of references, 23 text figures, and an index.

This is a subject most physicians know nothing about, but of which, in the present day trend to summarize end results and findings in statistical formulas, curves and charts, they

could afford to know a great deal. The book is one which medical authors should have near at hand.

MACLEOD'S PHYSIOLOGY IN MODERN MEDICINE. Edited by Philip Bard. Eighth Edition. St. Louis, 1938. C. V. Mosby Company. Price $8.50.

J. J. R. Macleod first brought this work out in 1918. He survived to bring out five more editions, but in 1935, just prior to the publication of the seventh edition, he died. When it was deemed necessary to bring out an eighth (the present) edition, Philip Bard, Professor of Physiology, at the Johns Hopkins University School of Medicine, was selected as eminently fitted for the task. He then invited a number of investigators to take part in the enterprise, and the volume is composed of the contributions of nine individuals (Henry C. Bazett, George R. Cowgill, Harry Eagle, Chalmers L. Gemmill, Magnus I. Gregersen, Roy G. Hoskins, J. M. D. Olmsted, and Carl F. Schmidt). Little of the seventh edition remains: the greater part of the work has been entirely rewritten.

The prefaces of the earlier editions stated that the purpose of the book was "to serve as a guide to the clinical application of physiology and biochemistry"; later (the fifth edition), the book was extended "in order that it may also be used as a textbook of physiology for students of medicine," and finally care was taken "to bring up to date those parts of the subject for which no application may be evident." This trend has been continued in the present edition.

This volume (1051 pages) is well illustrated, with ample references and an index, and may well serve as a textbook not only to medical students, but to those practicing medicine who desire to get up to date on physiology in modern medicine.

A TEXT-BOOK OF OPHTHALMIC OPERATIONS. By Harold Grimsdale, M.B., F.R.C.S., and Elmore Brewerton, F.R.C.S. Third Edition. Baltimore, 1937. William Wood & Co. Price $6.00.

This book has stood the test of time and is known to those who limit their work to surgery of the eye. Therefore, many will welcome a third edition.

In the preface to this new edition, the authors state: "It has been suggested to us that we have in the past dealt too much with historical operations. In the present edition we have excised much that had interest only in the development of operative surgery, and have tried, by leaving out unessential matter, to make a book more helpful to the student of ophthalmology." They have lived up well to this blueprint.

This book (322 pages) has 105 figures, a list of authorities at the conclusion of each chapter, and an ample index.

THE SCIENCE AND PRACTICE OF SURGERY. By W. H. C. Romanis, M.B., M.CH., F.R.C.S., F.R.S., and Philip H. Mitchiner, M.D., M.S., F.R.C.S. Sixth Edition. London, 1937. J. & A. Churchill, Ltd. 2 Volumes. Price 28 shillings.

The first edition of this two volume surgery appeared in 1927. Every year or two a new edition has appeared and now we are offered it in its sixth edition. Any work that reaches a sixth edition in ten years time needs no praise: this alone speaks for its worth and popularity.

In this edition a section has been added on the medical aspects of "gas," and the chapters on fractures and dislocations have been largely rewritten. The chapter on *x*-rays and ray therapy has been revised and brought up to date. The section on the sympathetic nervous system has been rewritten and enlarged. A number of new illustrations and plates have been included.

This book was written primarily for students, but the authors feel, and we readily concur, that this work will also prove valuable to those reading for higher surgical qualifications, as well as for the medical practitioner.

PRIMARY CARCINOMA OF THE LUNG. By Edwin J. Simons, M.D. Chicago, 1937. The Year Book Publishers, Inc. Price $5.00.

The author tells us in his preface that Dr. Evarts A. Graham had accepted his work for serial publication in the Journal of Thoracic Surgery, but found that continual lack of space for such an extended contribution made publication in book form more practical.

The study represents the composite efforts of many persons. The book covers: historical aspects, incidence, etiology, pathology, clinical considerations, and treatment of lung cancer with summary and conclusions at the end.

There is an ample bibliography, an index, and 30 figures, some in color.

This book of 263 pages is well written, scientifically sound (the chapter on treatment is alone worth the price of the book), and we recommend it to both internist and surgeon.

A Monograph on Veins. By Kenneth J. Franklin, D.M., M.R.C.P. Springfield, 1937. Charles C. Thomas. Price $6.00.

This is a book one cannot adequately review. Suffice it to state at the start that anyone interested in this subject, either from a surgical or medical viewpoint, will find this book invaluable. We are informed that only two other writers, Professor Klothilde Gollwitzer-Meier (1932) and M. L. Waterman (1933), have previously produced at all comprehensive and detailed works on the veins. In 1913, Professor J. A. Gunn, in conjunction with F. B. Chavasse, published a paper on the pharmacology of isolated veins. In 1924, he suggested to Dr. Franklin, that he continue the work. As a result the latter spent several years in research upon the venous system, and the present volume thus developed. In order to make available a somewhat recondite literature, which only a specialist could hope to summarize but which has, nevertheless, very definite bearings upon physiologic, pathologic, and clinical problems, this book was written.

The reading matter covers 350 pages, and there are forty-six illustrations. The bibliography is sixty pages long, but there is no index. Well written, and to the point, this book covers a subject of wide interest to most physicians.

Approved Laboratory Technic. Clinical, Pathological, Bacteriological, Mycological, Parasitological, Serological, Biochemical and Histological. By John A. Kolmer, M.D., and Fred Boerner, V.M.D. Second Edition. New York, 1938. D. Appleton-Century Company.

The first edition of this book appeared in 1931 and the work received a generous reception from medical students, physicians, teachers, clinical pathologists and laboratory technicians. In the first edition, the techniques and methods given were approved by committees selected from members of the American Society of Clinical Pathologists. In this edition they have been approved by members of a group of twenty-eight collaborators as well as, in many instances, by the authors of the methods themselves.

Each chapter has been thoroughly revised and the majority rewritten. During the past few years many new methods have been developed and added to the facilities of the clinical laboratory. The authors have selected those of approved value. Five new chapters have been added. Special emphasis has been placed on parasitology and added space given to mycology. Dr. A. V. St. George rewrote the chapter on Methods for Toxicological Examinations, in view of their importance in relation to medicolegal practice.

The text is especially well written (893 pages); there are twelve plates, 380 illustrations, and an index.

We feel that this book is sound and scientifically the last word. We may be prejudiced, however, for some years back, wishing to reward a young physician, we looked over the field and selected the first edition of this work, which we gave him as a present. Had we to repeat history, we would, again, select this, the second edition.

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